Report on Drainage Strategy to Accompany Planning Application for Land East of Chipping Lane, Longridge

by

Barratt Manchester

Revision	Date	Prepared By	Revision Notes
A	21.09.21	CD	Calculations revised to suit planning layout PL06 Revision -
B	12.01.22	CD	Inclusion of Phase 1 to model site as a whole
C	30.05.22	CD	Urban Creep section revised

Contents

Drawings

a. **459/ED/35**
b. **459/ED/127**

Appendices

A. **FRA Phase 1 – Betts Hydro – HYD068 – March 2016**
B. **FRA Phases 2 & 3 – Betts Hydro – HYD371 – November 2021**
C. **Hydraulic Assessment – Betts Hydro – HYD068_HA – July 2016**
D. **Site Investigation – soiltechnics - Omitted**
    a. **STN3505NM-G01 – Phase 1 – February 2016**
    b. **STN3505NM-G02 – Phase 2 – April 2016**
E. **Microdrainage Simulations**
    a. **1 in 2 Year**
    b. **1 in 30 Year**
    c. **1 in 30 Year (Surcharged Outfall)**
    d. **1 in 100 Year + 30% Climate Change**
    e. **Foul Water Design**

1. Introduction

The following document has been prepared to assist the designer's preparation and the readers understanding of the drainage theory and calculations in one reference document.

This document covers all Phases 1, 2 & 3 of the Chipping Lane development, in order to demonstrate how the full site drains; supporting evidence has been provided.

2. Site Details

Development Name	Chipping Lane
Site Address	Land off Chipping Lane, Longridge, Preston, PR3 2NA
Longitude, Latitude (or OS Grid Ref)	360321; 437929
Site Description	7 No. open grassed fields separated by mature hedgerows and sporadic trees. Currently used by livestock for grazing.
Site Area (Ha)	14.41Ha approx.
Site Area used for calculating Greenfield Runoff Rates (Ha)	10.52Ha approx. This excludes large areas of open spaces
Existing Impermeable Area (Ha)	0Ha
Is the Site Steeply Sloping (Y/N), If "Yes" Typical Gradient.	Yes 1:30

Table 1

3. Pre-Development Greenfield Runoff Rates (Phase 1)

A flood risk assessment which covers Phase 1 only, was carried out by Betts Hydro, dated March 2016. This document states that the surface water discharge rate should be restricted to 8.3 l/s/Ha, calculated using the ICP SUDS method within MicroDrainage. This FRA and discharge rate was approved under the planning application 3/2017/0232. See Appendix A for the Full Phase 1 report.

Return Period	**Greenfield Rate (l/s/Ha)**
1 in 1 year (l/s)	7.2
Qbar	8.3
1 in 30 year (l/s)	14.0
1 in 100 year (l/s)	17.2

Table 2

4. Pre-Development Greenfield Runoff Rates (Phases 2 & 3)

A flood risk assessment which covers Phase 2 & 3, was carried out by Betts Hydro, dated December 2018. This document states that the surface water discharge rate should be restricted to 13.6 l/s/Ha, calculated using the HR Wallingford tool for greenfield runoff rates on uksuds.com. This FRA and discharge rate was approved under the planning application 3/2018/0975.

This FRA was revised in November 2021 to include for the new planning layout amendments, for the replan application 3/2021/1134. The drainage strategy and discharge rates emulates the previously approved rate of 13.6 l/s/Ha. See Appendix B for the latest revision of the Full Phases 2 & 3 report.

Return Period	Greenfield Rate (l/s/Ha)
1 in 1 year (l/s)	11.8
Qbar	13.6
1 in 30 year (l/s)	23.1
1 in 100 year (l/s)	28.3

Table 3

5. Soakaway Testing

A site specific site investigation was carried out by soiltechnics dated February 2016. A copy of the site investigation is presented in Appendix D.

Ground conditions are typically 0.3m of topsoil overlaying cohesive Devensian Till to beyond depths of 4.7m. The Till is comprised of initially 1-1.5m of low to high strength clay, below which the shear strength increases. Varying amounts of silt, sand and gravel were also found.

2 No. soakway tests were carried out as part of the site investigation. It was considered that the Devensian Till is impermeable and therefore indicates that infiltration drainage is NOT a feasible option.

6. Post-Development Surface Water Allowable Discharge Rates (All Phases)

Discharge rates have been limited to existing greenfield runoff rates of Qbar for all storm return periods. Please refer to the phase specific FRA, and Tables 2 and 3 above for details of the greenfield runoff rates.

For the Development Area refer to drawing 459/ED/146.

Phase	Developable Area (Ha)	Greenfield Rate (l/s/Ha)	Allowable Discharge Rate (l/s)
1	4.32	8.3	35.9
2A	1.80	13.6	24.5
2B	2.69	13.6	36.6
3	1.71	13.6	23.2
		TOTAL	**120.2**

Table 4

Phase 2A is to drain into the existing sewers of Phase 1, these have now been combined into one Network 1, so that they can be modelled together.

Surface Water Networ	Developable Area (Ha)	Allowable Discharge Rate (l/s)
Network 1	6.12	60.4
Network 3	2.69	36.6
Network 4	1.71	23.2
	TOTAL	**120.2**

Table 5

7. Design Parameters

M5-60	18.800
Ratio R	0.282
MADD Factor	2.0
Climate Change Allowance	30%
Urban Creep	10%

Table 6

Point of Connection	S14	S325	S415
Engineering Layout Drg No	459/ED/02	459/ED/105	459/ED/105
Proposed Impermeable Areas Drg No	459/ED/04	459/ED/103	459/ED/103
Lowest FFLs	105.175	107.400	111.900
Maximum TWL for Design (Lowest FFL – 0.6m)	104.575	106.800	111.300
Discharge Location Minimum Levels	102.040	106.860	111.120
Surcharge Outfall Levels	102.560	104.400	109.370
Point of Connection	Watercourse		
Point of Connection approved by UU (Y/N)	Yes		

Table 7

8. Summary of Drainage Design

The drainage has been designed in accordance with the site specific FRAs produced by Betts Hydro dated March 2016 & November 2021.

The drainage has also been designed to comply with DEFRA's non-statutory technical standard for sustainable drainage systems dated March 2015. Compliance to such is demonstrated within Section 14.

All surface water networks will drain to the adjacent watercourse named Higgin Brook. Discharge rates have been limited to existing greenfield runoff rates of Qbar for all storm return periods.

Attenuation storage is provided in the form of oversized pipes under highways and public open spaces. Attenuation storage in the highways is sized to provide attenuation for all flows up to and including 1 in 30 year storm events.

For storm events exceeding 1 in 30 year events, long term storage is provided in above ground storage areas to ensure no flooding to properties occurs for all storm events up to and including 1 in 100 year 6 hour storm events plus a 30% allowance for climate change.

An allowance of 30% climate change was approved within the FRAs for planning applications 3/2017/0232 and 3/2018/0975, therefore has been adopted for this small replan application.

MicroDrainage simulations are available in Appendix E and demonstrate the Actual Discharge Rates.

Drainage Network	**Allowable Discharge Rate (l/s)**	**Actual Discharge Rate (l/s)**	**Difference (l/s)**
1	60.3	49.9	-10.4
3	36.6	41.8	5.2
4	23.3	26.4	3.1
Total	**120.2**	**118.1**	**-2.1**

Table 8

9. Urban Creep

When calculating the proposed impermeable areas for the development, an additional 10% has been added to the areas of domestic properties to represent Urban Creep. This 10% has been applied for all phases; and is shown on the impermeable area plans. These increased areas have been used on all pipe codes within MicroDrainage, in order to design and model the system with greater areas of impermeability. The MicroDrainage calculations are found in Appendix E.

10. Design for Exceedance

All surface water drainage models have been modelled for storm events greater than the 1 in 100 year event to determine the impact of flooding. The flood locations are shown on the attached Flood Routing and over land flow drawings. Any exceedance flooding have been demonstrated to be managed within the site where reasonable practicable.

This demonstrates that properties are unlikely to flood during extreme flood events.

11. Maintenance

All surface water (coloured blue) on the attached plans, 459/ED/02 and 459/ED/105, will be put forward for adoption under a Section 104 Agreement with United Utilities. Prior to issue of the Vesting Declaration by United Utilities, the drainage shown on the included plan will be maintainable by Barratt Manchester at the expense of Barratt Manchester.

All areas of public open space will be transferred to the management company for adoption and maintenance. This includes the overflow areas/ponds and culverts to the watercourse on the attached plans 459/ED/02 and 459/ED/105. The management and maintenance will be funded by the purchasers/owners of the development by way of an annual fee levied on the owner. In order to ensure the long term operation of the swales, the maintenance contract will stipulate regular maintenance of the SuDS network, in accordance with the management plan.

All highway gullies and highway drains on the attached plan will be put forward for adoption under a Section 38 agreement with Lancashire County Council. After issue of the highway final certificate, the highways and highway drains, gullies and gully pipes on the attached plans 459/ED/02 and 459/ED/105, will be maintainable by the Local Highway Authority at public expense. Prior to the issue of the final certificate by LCC, the roads and drainage will be maintainable by Barratt Manchester at the expense of Barratt Manchester.

All foul drainage (coloured brown) on the attached plans 459/ED/02 and 459/ED/105 will be put forward for adoption under a S104 agreement with United Utilities. Prior to issue of the Vesting Declaration by United Utilities, the drainage shown on the included plan will be maintainable by Barratt Manchester and at the expense of Barratt Manchester.

A draft inspection & maintenance schedule for elements of the SuDS/Drainage infrastructure is shown in Table 9.

Drainage Element	Maintenance Requirement	Frequency
Surface Water Pipes and Manholes (prior to adoption)	Inspect. Remove excess silt & debris, Clear Blockage	Inspect Annually. CCTV if required. Silt & debris removed as necessary.
Catchpits	Inspect. Remove excess silt & debris, Clear Blockage	Inspected every 3 months. Silt & debris removed as necessary.
Ditches/Swales	Inspect. Remove excess vegetation. Clear blockages, silt & debris.	Inspected every 1 Month. Blockages, silt & debris removed as necessary.
Flow Controls	Inspect. Remove excess silt & debris, clear blockage. Test functionality of Bypass doors.	Inspect Annually Silt & debris removed as necessary. Flow control repaired, maintained as necessary.
Overflow Ponds (and POS)	Inspect. Remove excess vegetation. Clear blockages, silt & debris.	Inspected monthly, or after significant storm events. Blockages, silt & debris removed as necessary.

Table 9

Culverting sections of the existing watercourse may create or exacerbate upstream or downstream bank and bed erosion as well as sediment deposition, as a result of altered water velocities and disruption to the natural transport of sediment. In order to reduce the effects of erosion we plan to do the following:

- The culvert base matches the existing bed to allow a naturalised culvert bed during high velocity flows
- The culvert width is the same width as the natural channel
- The soffit of the culvert is greater than the 1 in 1000 year water levels
- Culvert alignment matches the alignment of the watercourse
- The slope of the culvert base matched the slope of the existing bed of the watercourse
- No steps provided between end of headwall and the existing bed of the watercourse

Additional headwalls onto existing watercourse can also create or exacerbate bank and bed erosion as well as sediment deposition. In order to reduce the effects of erosion we plan to do the following:

- Flows have been restricted to mimic Qbar greenfield runoff rates, flows will not be increased
- Outfall structure sits flush with the existing bank to prevent turbulent flows
- Headwalls to be located on straight sections of watercourse
- Headwall alignment to be at angle of 45^{o} to minimise change of flow direction
- Outflow pipes of velocity less than 1.2 m/s
- Height between outlet invert and watercourse bed minimised

Screens/grilles are fitted on all headwalls with pipes 375mm or greater. Screens serve two purposes: a trash screen to prevent floating debris and a security screen to restrict access from unauthorised people. Screens are fitted with 100mm spacings between bars so as not to hinder passage of fish and other fauna. The maintenance of screens is safer and easier than clearing potential blockages within the culverts themselves. Maintenance will be in line with that described in Table 6.

12. Defect Reporting

Prior to adoption of the highway drains, foul drains, surface water drains, SuDS and culverts, defects may be reported to Barratt Manchester by the local authority, local residents or members of the public.

All defects can be reported to Barratt Manchester Customer Care line using the following details:

Email: manchester@newhomecare.co.uk

Phone: 0161 872 0161 Option 3

Phone (Out-of-Hours): 0345 601 6084

The customer care line's normal working hours are Monday to Friday 9:00 to 17:30, excluding bank holidays. The out-of-hours line is a 24-hour call service.

After adoption, the following numbers may be useful:

Management Company
POS Landcare Ltd
Hillhouse Business Park,
Thornton Cleveleys,
Lancashire
FY5 4QD
Tel: 01253 897 824

Lancashire County Council Highways
www.lancashire.gov.uk/roads-parking-and-travel/report-it/
Tel: 0300 123 6780 (Mon-Fri 8:00 to 17:00, exc. Bank Holidays)

United Utilities
Tel: 0345 672 3723

Environment Agency
Tel: 0800 80 70 60 (24 Hours)

13. Response Times

All non-urgent defects will be repaired within 10 weeks of being reported.

All urgent defects will be made safe within 48 hours, or sooner if practicable. Any works to 'Make Safe' may be a temporary measure in order to protect the public, and allow sufficient time to procure the permanent remedial works. This may include temporary 'fencing off' of the hazard until permanent remedial works can be completed.

United Utilities, Local Authority, Environment Agency, and the Management Company may operate to alternative response times.

Refer to the site landscape maintenance schedule for further details on the site wide schedule.

14. Compliance with DEFRA's Non-Statutory Technical Standards for Sustainable Drainage Systems dated March 2015

Flood risk outside the development

Criteria	Designers Comments
S1 Where the drainage system discharges to a surface water body that can accommodate uncontrolled surface water discharges without any impact on flood risk from that surface water body (e.g. the sea or a large estuary) the peak flow control standards (**S2** and **S3** below) and volume control technical standards (**S4** and **S6** below) need not apply.	The surface water discharges to existing watercourse/sewer, therefore this criteria does not apply.

Peak flow control

Criteria	Designers Comments
S2 For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should never exceed the peak greenfield runoff rate for the same event.	All proposed discharge rates are less than or equal to Qbar. Therefore this criteria is deemed to comply.
S3 For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.	The site is greenfield therefore not applicable. Therefore, this criteria is deemed to comply.

Volume control

Criteria	Designers Comments
S4 Where reasonably practicable, for greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event should never exceed the greenfield runoff volume for the same event.	As the infiltration test results do not allow infiltration drainage, it is not possible to reduce the run-off volume to the greenfield volume, therefore Criteria S6 will apply.

S5 Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event.	The site is Greenfield therefore not applicable.
S6 Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with **S4** or **S5** above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.	As the infiltration test results do not allow infiltration drainage, it is not possible to reduce the run-off volume to the greenfield volume, therefore the discharge rate has been reduced to a maximum of Qbar for all rainfall events up to and including 1 in 100 year 6 hour event.

Flood risk within the development

Criteria	**Designers Comments**
S7 The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year rainfall event.	The drainage system has been designed to ensure no flooding occurs for any part of the site for a 1 in 30 year event. Micro drainage simulation for a 1 in 30 year event are attached in Appendix D
S8 The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development.	The drainage system has been designed to ensure no flooding to properties occurs for any part of the site for a 1 in 100 year 6 Hour event. For flows in excess of the 1 in 30 year event, flows are allowed to overflow into Long Term Storage areas located in public open spaces. Some minor flooding to highways is accepted for the 1 in 100 year 6 hour event. Flooding is only permitted where it can be demonstrated that minor flooded is contained wholly within the adopted highway and will not flood properties. The location and flood extent are shown on the Flood Routing and Overland Flow drawing. Micro drainage simulation for a 1 in 100 year event are attached in Appendix D

S9 The design of the site must ensure that, so far as is reasonably practicable, flows resulting from rainfall in excess of a 1 in 100 year rainfall event are managed	All surface water drainage models have been modelled for storm events greater than the 1 in 100 Year event to determine the impact of flooding. The Flood locations are shown on the attached Flood Routing and over land flow drawing. Any exceedance flooding has been demonstrated to be managed within the site where reasonably practicable.

Structural integrity

Criteria	Designers Comments
S10 Components must be designed to ensure structural integrity of the drainage system and any adjacent structures or infrastructure under anticipated loading conditions over the design life of the development taking into account the requirement for reasonable levels of maintenance.	All Sewers are to be covered under a S104 agreement with United Utilities for future adoption. All sewers to be built to UU adoptable standards. A 12 month maintenance period is standard with all S104 sewers
S11 The materials, including products, components, fittings or naturally occurring materials, which are specified by the designer must be of a suitable nature and quality for their intended use.	All main sewers to be constructed to adoptable standards. All SUDS to be constructed in accordance with the Typical details as provided.

Designing for maintenance considerations

Criteria	Designers Comments
S12 Pumping should only be used to facilitate drainage for those parts of the site where it is not reasonably practicable to drain water by gravity.	Surface Water Pump Stations are not proposed on this development. A Foul ONLY Pump Stations is provided only where it is not possible to drain foul by gravity.

Construction

Criteria	Designers Comments
S13 The mode of construction of any communication with an existing sewer or drainage system must be such that the making of the communication would not be prejudicial to the structural integrity and functionality of the sewerage or drainage system.	All Sewers are to be covered under a S104 agreement with United Utilities for future adoption. All sewers to be built to UU adoptable standards. Connection to the ordinary watercourse will require LLFA land drainage consent. Details of the works have been submitted to the LLFA and subsequently approved. No works to within 8m of an ordinary watercourse will be permitted without LLFA approval.

S14 Damage to the drainage system resulting from associated construction activities must be minimised and must be rectified before the drainage system is considered to be completed.	All Sewers are to be covered under a S104 agreement with United Utilities for future adoption. All sewers to be built to UU adoptable standards. A 12 month maintenance period is standard with all S104 sewers. Connection to the ordinary watercourse will require LLFA land drainage consent. Details of the works have been submitted to the LLFA and subsequently approved. No works to within 8m of an ordinary watercourse will be permitted without LLFA consent.

STATION COORDINATES			
STN	EASTING	NORTHING	LEVEL
1	360046.052	438075.076	103.669
2	359973.983	437900.946	106.736
3	360102.172	438230.032	102.057
4	360076.497	438151.762	102.828
5	360008.857	437979.182	105.422
6	359999.234	437904.541	106.859
7	360104.416	437864.142	108.238
8	359921.449	437923.762	107.573
9	360119.741	437817.117	108.854
10	360130.204	437783.994	109.568
11	360157.741	437659.066	110.954
12	360079.844	438031.962	104.603
13	360063.229	437955.005	106.341
14	360014.283	437940.169	106.927
15	360114.155	437931.710	106.413
16	360154.700	438003.288	105.614
17	360227.466	438045.530	104.996
18	360097.270	438206.420	102.297
19	360156.766	438199.392	102.063
20	360243.079	438203.966	102.496
21	360260.817	438131.083	104.164
22	360292.389	438086.190	105.355
23	360299.904	438037.938	106.727
24	360225.836	437937.023	106.905
25	360263.673	437997.737	106.553
26	360268.820	437872.795	108.110
27	360294.128	437838.604	110.031
28	360275.391	437806.285	110.249
29	360388.929	437840.149	112.160
30	360354.799	437823.947	111.299
31	360354.542	437796.389	111.674
32	360356.251	437771.532	111.852
33	360465.377	437946.664	113.645
34	360540.863	437934.736	115.716
35	360442.676	438077.345	110.300
36	360637.883	437966.054	117.404
37	360382.216	437955.964	111.717
38	360492.729	437863.633	115.614
39	360703.590	437826.133	122.026
40	360398.931	438016.872	110.454
41	360368.257	438088.084	107.813

Legend (Topographical)

SURVEY GRID AND LEVELS ARE DEFINED UTILISING THE LEICA SMARTNET GNSS NETWORK.
ONLY MANHOLES FOUND DURING THE SITE SURVEY ARE INDICATED ON THIS PLAN. FURTHER INVESTIGATION MAY BE REQUIRED TO DETERMINE THE FULL EXTENT OF THE SITE DRAINAGE.

ISSUE	REVISION	DATE
D	GARAGE OFF INGLEWHITE ROAD NEW BOUNDARY FENCE SURVEYED.	09.02.18.
C	INGLEWHITE ROAD SURVEY EXTENDED.	20.09.17.
B	MANHOLE SURVEY ADDED.	01.11.16.

Project
INGLEWHITE ROAD,
LONGRIDGE,
PRESTON.

Drawing title
SITE SURVEY.

Scales 1:500 Date 31.01.2013

Drawing number SDL 2062/1. Rev. D. Drawn by BJ

CLIENT BARRATT HOMES MANCHESTER.
CITY PARK,
4 BRINDLEY ROAD,
MANCHESTER. M16 9HQ.
TEL: 0161 872 0161.

Survey & Design Limited
28 RAILWAY ROAD, LEIGH, LANCS, WN7 4AU
Tel: 01942 673136, Fax: 01942 607054
Email: bryn@surveyanddesign.co.uk
LAND SURVEYING ○ DESIGN CONSULTANTS
CIVIL ○ ARCHITECTURAL ○ PLANNING

PRESTON.

Drawing title

SITE SURVEY.

Scales 1:500 Date 31.01.2013

Drawing number SDL 2062/3. Rev. C. Drawn by BJ

CLIENT BARRATT HOMES MANCHESTER.
CITY PARK,
4 BRINDLEY ROAD,
MANCHESTER. M16 9HQ.
TEL: 0161 872 0161.

Survey & Design Limited
28 RAILWAY ROAD, LEIGH, LANCS, WN7 4AU
Tel: 01942 673136, Fax: 01942 607054
Email: bryn@surveyanddesign.co.uk
LAND SURVEYING ∘ DESIGN CONSULTANTS
CIVIL ∘ ARCHITECTURAL ∘ PLANNING

STATION COORDINATES

STN	EASTING	NORTHING	LEVEL
1	360046.052	438075.076	103.669
2	359973.983	437900.946	106.736
3	360102.172	438230.032	102.057
4	360076.497	438151.762	102.828
5	360008.857	437979.182	105.422
6	359999.234	437904.541	106.859
7	360104.416	437864.142	108.238
8	359921.449	437923.762	107.573
9	360119.741	437817.117	108.854
10	360130.204	437783.994	109.568
11	360157.741	437659.066	110.954
12	360079.844	438031.962	104.603
13	360063.229	437955.005	106.341
14	360014.283	437940.169	106.927
15	360114.155	437931.710	106.413
16	360154.700	438003.288	105.614
17	360227.466	438045.530	104.996
18	360097.270	438206.420	102.297
19	360156.766	438199.392	102.063
20	360243.079	438203.966	102.496
21	360260.817	438131.083	104.164
22	360292.389	438086.190	105.355
23	360299.904	438037.938	106.727
24	360225.836	437937.023	106.905
25	360263.673	437997.737	106.553
26	360268.820	437872.795	108.110
27	360294.128	437838.604	110.031
28	360275.391	437806.285	110.249
29	360388.929	437840.149	112.160
30	360354.799	437823.947	111.299
31	360354.542	437796.389	111.674
32	360356.251	437771.532	111.852
33	360465.377	437946.664	113.645
34	360540.863	437934.736	115.716
35	360442.676	438077.345	110.300
36	360637.883	437966.054	117.404
37	360382.216	437955.964	111.717
38	360492.729	437863.633	115.614
39	360703.590	437826.133	122.026
40	360398.931	438016.872	110.454
41	360368.257	438088.084	107.813

SURVEY GRID AND LEVELS ARE DEFINED UTILISING THE LEICA SMARTNET GNSS NETWORK.
ONLY MANHOLES FOUND DURING THE SITE SURVEY ARE INDICATED ON THIS PLAN. FURTHER INVESTIGATION MAY BE REQUIRED TO DETERMINE THE FULL EXTENT OF THE SITE DRAINAGE.

ISSUE	REVISION	DATE
D	GARAGE OFF INGLEWHITE ROAD NEW BOUNDARY FENCE SURVEYED.	09.02.18.
C	INGLEWHITE ROAD SURVEY EXTENDED.	20.09.17.
B	MANHOLE SURVEY ADDED.	01.11.16.

Project

INGLEWHITE ROAD,
LONGRIDGE,
PRESTON.

Drawing title

SITE SURVEY.

Scales 1:500 Date 31.01.2013

Drawing number SDL 2062/1. Rev. D. Drawn by BJ

CLIENT BARRATT HOMES MANCHESTER.
CITY PARK,
4 BRINDLEY ROAD,
MANCHESTER. M16 9HQ.
TEL: 0161 872 0161.

Survey & Design Limited
28 RAILWAY ROAD, LEIGH, LANCS, WN7 4AU
Tel: 01942 673136, Fax: 01942 607054
Email: bryn@surveyanddesign.co.uk
LAND SURVEYING ∘ DESIGN CONSULTANTS
CIVIL ∘ ARCHITECTURAL ∘ PLANNING

SURVEY GRID AND LEVELS ARE DEFINED UTILISING THE LEICA SMARTNET GNSS NETWORK.
ONLY MANHOLES FOUND DURING THE SITE SURVEY ARE INDICATED ON THIS PLAN. FURTHER INVESTIGATION MAY BE REQUIRED TO DETERMINE THE FULL EXTENT OF THE SITE DRAINAGE.

ISSUE	REVISION	DATE
C	INGLEWHITE ROAD SURVEY EXTENDED.	20.09.17.
B	MANHOLE SURVEY ADDED.	01.11.16.

Project

INGLEWHITE ROAD,
LONGRIDGE,
PRESTON.

Drawing title

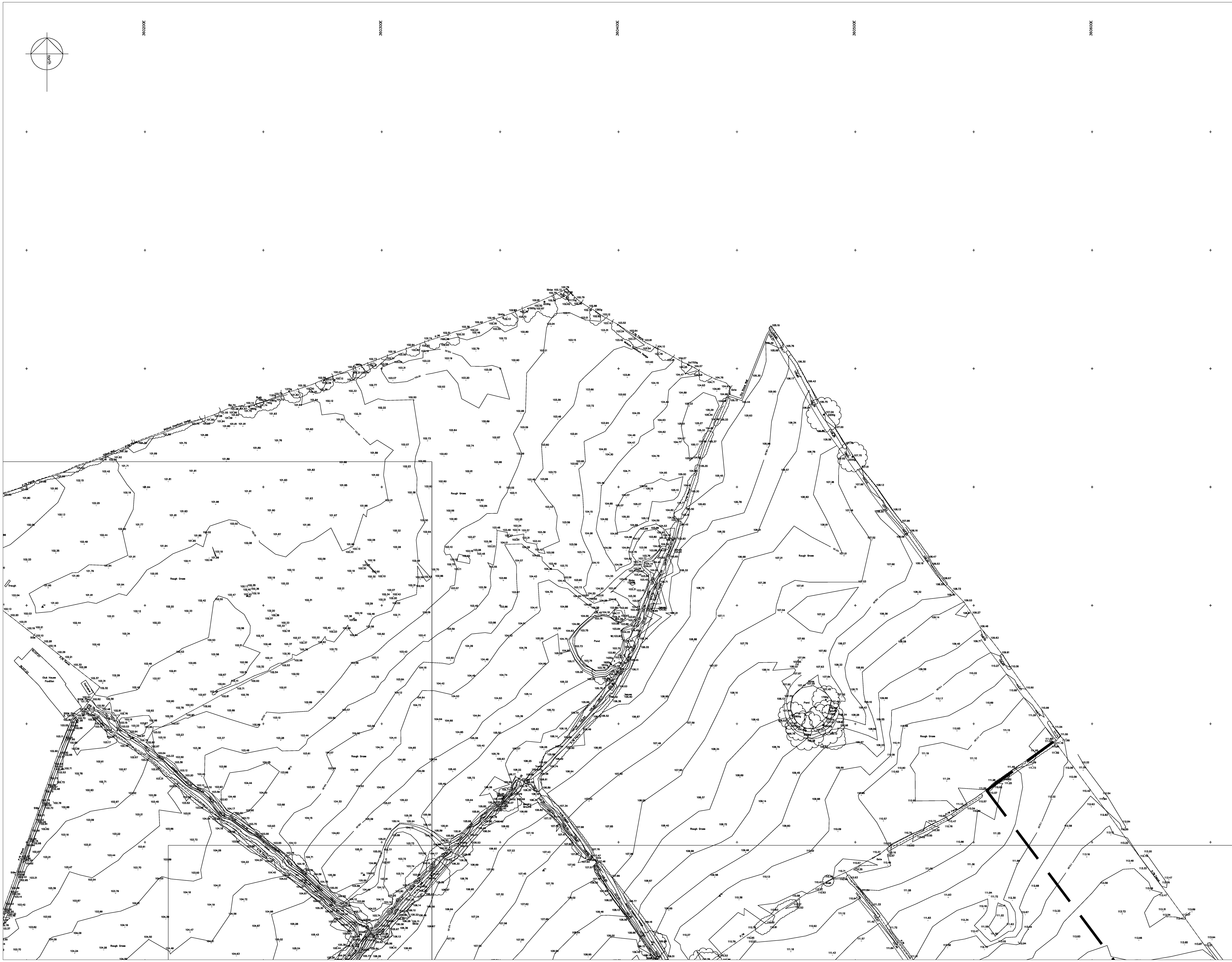
SITE SURVEY.

Scales 1:500 Date 31.01.2013

Drawing number SDL 2062/2. Rev. C. Drawn by BJ

CLIENT BARRATT HOMES MANCHESTER.
CITY PARK,
4 BRINDLEY ROAD,
MANCHESTER. M16 9HQ.
TEL: 0161 872 0161.

Survey & Design Limited
28 RAILWAY ROAD, LEIGH, LANCS, WN7 4AU
Tel: 01942 673136, Fax: 01942 607054
Email: bryn@surveyanddesign.co.uk
LAND SURVEYING ∘ DESIGN CONSULTANTS
CIVIL ∘ ARCHITECTURAL ∘ PLANNING



STATION COORDINATES			
STN	EASTING	NORTHING	LEVEL
1	360046.052	438075.076	103.669
2	359973.983	437900.946	106.736
3	360102.172	438230.032	102.057
4	360076.497	438151.762	102.828
5	360008.857	437979.182	105.422
6	359999.234	437904.541	106.859
7	360104.416	437864.142	108.238
8	359921.449	437923.762	107.573
9	360119.741	437817.117	108.854
10	360130.204	437783.994	109.568
11	360157.741	437659.066	110.954
12	360079.844	438031.962	104.603
13	360063.229	437955.005	106.341
14	360014.283	437940.169	106.927
15	360114.155	437931.710	106.413
16	360154.700	438003.288	105.614
17	360227.466	438045.530	104.996
18	360097.270	438206.420	102.297
19	360156.766	438199.392	102.063
20	360243.079	438203.966	102.496
21	360260.817	438131.083	104.164
22	360292.389	438086.190	105.355
23	360299.904	438037.938	106.727
24	360225.836	437937.023	106.905
25	360263.673	437997.737	106.553
26	360268.820	437872.795	108.110
27	360294.128	437838.604	110.031
28	360275.391	437806.285	110.249
29	360388.929	437840.149	112.160
30	360354.799	437823.947	111.299
31	360354.542	437796.389	111.674
32	360356.251	437771.532	111.852
33	360465.377	437946.664	113.645
34	360540.863	437934.736	115.716
35	360442.676	438077.345	110.300
36	360637.883	437966.054	117.404
37	360382.216	437955.964	111.717
38	360492.729	437863.633	115.614
39	360703.590	437826.133	122.026
40	360398.931	438016.872	110.454
41	360368.257	438088.084	107.813

SURVEY GRID AND LEVELS ARE DEFINED UTILISING THE LEICA SMARTNET GNSS NETWORK.
ONLY MANHOLES FOUND DURING THE SITE SURVEY ARE INDICATED ON THIS PLAN. FURTHER INVESTIGATION MAY BE REQUIRED TO DETERMINE THE FULL EXTENT OF THE SITE DRAINAGE.

ISSUE	REVISION	DATE
C	INGLEWHITE ROAD SURVEY EXTENDED.	20.09.17.
B	MANHOLE SURVEY ADDED.	01.11.16.

Project
INGLEWHITE ROAD,
LONGRIDGE,
PRESTON.

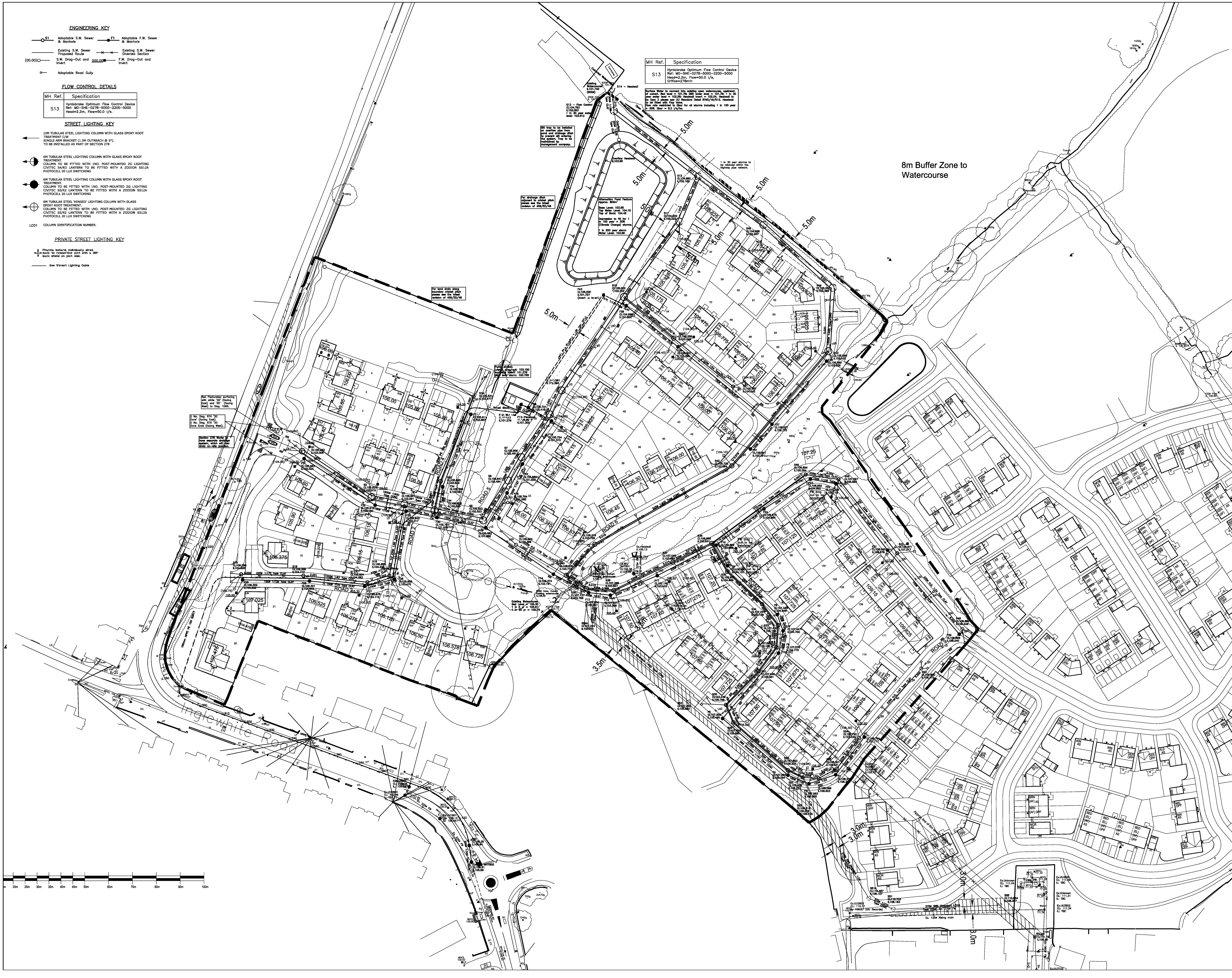
Drawing title
SITE SURVEY.

Scales 1:500 Date 31.01.2013

Drawing number SDL 2062/3. Rev. C. Drawn by BJ

CLIENT BARRATT HOMES MANCHESTER.
CITY PARK,
4 BRINDLEY ROAD,
MANCHESTER. M16 9HQ.
TEL: 0161 872 0161.

Survey & Design Limited
28 RAILWAY ROAD, LEIGH, LANCS, WN7 4AU
Tel: 01942 673136, Fax: 01942 607054
Email: bryn@surveyanddesign.co.uk
LAND SURVEYING ○ DESIGN CONSULTANTS
CIVIL ○ ARCHITECTURAL ○ PLANNING



ENGINEERING KEY

- S1 — Adoptable S.W. Sewer & Manhole
- F1 — Adoptable F.W. Sewer & Manhole
- Existing S.W. Sewer Proposed Route
- Existing S.W. Sewer Diverted Section
- (00.00) — S.W. Drag-Out and Invert
- 000.00 — F.W. Drag-Out and Invert
- Adoptable Road Gully

FLOW CONTROL DETAILS

MH Ref.	Specification
S13	Hyrdobrake Optimum Flow Control Device Ref: MD-SHE-0278-5000-2200-5000 Head=2.2m, Flow=50.0 l/s.

STREET LIGHTING KEY

10M TUBULAR STEEL LIGHTING COLUMN WITH GLASS EPOXY ROOT TREATMENT C/W SINGLE ARM BRACKET (1.5M OUTREACH @ 5°). TO BE INSTALLED AS PART OF SECTION 278

6M TUBULAR STEEL LIGHTING COLUMN WITH GLASS EPOXY ROOT TREATMENT. COLUMN TO BE FITTED WITH 1NO. POST-MOUNTED ZG LIGHTING CIVITEC S4/R3 LANTERN TO BE FITTED WITH A ZODION SS12A PHOTOCELL 20 LUX SWITCHING

6M TUBULAR STEEL LIGHTING COLUMN WITH GLASS EPOXY ROOT TREATMENT. COLUMN TO BE FITTED WITH 1NO. POST-MOUNTED ZG LIGHTING CIVITEC S5/R2 LANTERN TO BE FITTED WITH A ZODION SS12A PHOTOCELL 20 LUX SWITCHING

6M TUBULAR STEEL 'HINGED' LIGHTING COLUMN WITH GLASS EPOXY ROOT TREATMENT. COLUMN TO BE FITTED WITH 1NO. POST-MOUNTED ZG LIGHTING CIVITEC S5/R2 LANTERN TO BE FITTED WITH A ZODION SS12A PHOTOCELL 20 LUX SWITCHING

LC01 COLUMN IDENTIFICATION NUMBER.

PRIVATE STREET LIGHTING KEY

Pharola bollard, individually wired back to respective plot with a 180° back shield on plot side.

6mm Street Lighting Cable

WARNING TO HOUSE-PURCHASERS

Property Misdescriptions Act 1991

Buyers are warned that this is a working drawing and is not intended to be treated as descriptive material describing, in relation to any particular property or development, any of the Specified matters prescribed by any Order made under the above Act. The contents of this drawing may be subject to change at any time and alterations and variations can occur during the progress of the works without revision of the drawing. Consequently the layout, form, content and dimensions of the finished construction may differ materially fron those shown. Nor do the contents of this drawing constitute a contract, part of any contract or warranty.

ENGINEERING LAYOUT NOTES

1. All adoptable drainage works have been designed and are to be constructed in accordance with 'Sewers for Adoption, 6th Edition', and United Utilities 'Guidelines for Sewer for adoption 6th Edition'. Where specification conflicts, UU guidelines shall take presidence.

United Utilities Standard details to be used are:

STND/19/001A	Manhole Type 1
STND/19/002A	Manhole Type 2 and Invert Access Detail
STND/19/003A	Shallow Manhole Detail for Small Diameter Pipes (Type 4)
STND/19/004A	Shallow Surface Water Manhole Detail – Restricted Headroom (less than 2.0m) – For Pipe Sizes 450Dia and Above
STND/19/005A	Flow Control Manhole Detail
STND/19/007A	External Backdrop Detail
STND/19/008A	Pipe Bedding Detail
STND/19/010A	Variable Manhole – Guidance Notes
STND/19/011A	Headwall Type 1 and Typical Outlet Grille Detail
STND/19/012A	Typical Outfall Details Type 2 & Type 3

2. All clay pipe work shall be Extra Strength Clayware to BS 295 and BS 65 (SW pipes only).

3. All precast concrete pipework shall be to Class 120 in accordance with BS5911 Part 1, BS EN 1916 and bear the BS kitemark.

4. All adoptable drainage to be bedded in Class S granular surround unless otherwise stated.

5. All Concrete manholes and Soakaways rings, Concrete cover slabs and Con to be manufactured to BS EN 1917 and BS 5911:Part 3.

6. Rising Mains to be Black Polyethylene Pipes complying to BS EN 13244–2. Polyethylene fittings, including fusion joints, and electro–fusion fittings shall comply with BS EN 13244–2.

7. All levels relate to Ordnance Datum. Contractor to ensure that this drawing is read in conjuction with the site specific Topographical Survey provided by Barratt Manchester and the Benchmark information provided.

8. This drawing is to be read in accordance with all other relevant drawings.

9. The contractor shall be responsible for ensuring that any existing invert levels indicated on the drawings are correct before work commences.

10. All proposed connections to the sewer shall be 150ø unless stated otherwise.

11. All private house drainage shall be 100ø and all drag–out connections shall be 150ø at a minimum gradient of 1:80 unless otherwise stated and laid in accordance with Part H of the the Building Regulations.

12. Runoff from private surfaces shall not discharge across the highway. Gullies or channels shall be provided as appropriate to prevent this.

13. Pram crossings shall be provided at the inner tangent points of all junctions.

14. Pipes shall be protected from concentrated loading by construction traffic during the construction period when insufficient cover to the pipe may make them vulnerable to damage.

15. Insitu CBR tests of the road formation level are to be carried out to determine the depth of pavement construction required. This is to be approved by the adopting authority prior to construction of the road pavements.

16. Groundworker to ensure that plot drainage be within the curtilage of the plot they serve where possible and inspection covers kept within hardstandings where possible.

17. Contractor to provide United Utilities with sufficient notice prior to commencement of Sewer works on their Inspections telephone number. Tel 0845 602 0406.

18. Contractor to obtain all necessary Highway opening notices from the relevant Local Authority, obtain approval to work on United Utilities Sewerage System, obtain approval to method statement from the Environment Agency for any works affecting a watercourse.

19. All manholes adopted by TMBC to have a minimum 150mm ST4 concrete surround to full depth.

STREET LIGHTING NOTES

1. Feeder pillar shall be factory supplied and include a compliance test certificate. Lighting Special Details are specified on sheets NL2, NL4 and NL5, if required. Maximum cable size with feeder pillars shall be $16mm^2$ conductor size.
2. The 'NL' series for Lighting Special Details shall be used in conjunction with this drawing.
3. All new lighting columns and illuminated signs/bollards number specifications shall be in accordance with NL12. A numbering schedule shall be obtained for all new columns from Lancashire County Council (01772 531202) upon completion. Seven days notice is required following submission of an as–built plan.
4. The regional electric company is Electricity North West Ltd. An Independent Connections Provider can be used within the LCC area for signle phase connections, transfers and disconnections.
5. All supply cables to new or existing lighting columns shall be enclosed in 50/100mm internal diameter orange, medium/high density polyethylene service duct, unless otherwise stated.
6. All street lighting equipment shall be sited within the specified adoptable footpath or verge. Lighting columns shall be sited at the back of the footway with the door facing across the road.

REV	DESCRIPTION	DATE	DRAWN
34	Speed roundels moved; F14 & S40 cover levels revised to suit raised table revision	18.06.20	CD
33	Bollards to the front of plots 59–62 amended.	19.12.19	FB
32	S55–S52 surface water diversion revised to suit Phase 2 highway levels	08.11.19	CD
31	S55–S52 surface water diversion revised to suit Phase 2; FFL for Plots 79 & 93–94 revised	09.10.19	CD
30	FFL for Plots 71–124 revised; Drag outs revised and notes added	12.07.19	CD
29	FFL for Plots 71–85 revised	19.06.19	CD
28	FFL for Plots 88–92 revised	04.04.19	CD
27	REVISED IN LINE WITH WITH REPLAN LAYOUT 7. ROAD 9 REVISED	21.11.18	CD
Z	STREET LIGHTING BOLLARD ADDED TO PLOT 3.	29.10.18	FB
Y	STREET LIGHT LCO4 AMENDED TO LC35.	24.05.18	FB
X	CRICKET PITCH DRAINAGE DITCH REVISED	23.05.18	CD
W	LEVELS REVISED FOR ROADS 1 & 6; FFLS REVISED FOR PLOTS 35–36; 52–57; 76–80 & 86–87; S39 MOVED; SW DIVERSION CONNECTION REVISED	24.04.18	CD
V	STREET LIGHTING AMENDED TO SIT WITHIN ADOPTABLE HIGHWAY.	21.02.18	FB
U	DRAINAGE DITCH ALONG SOUTHERN BOUNDARY OF CRICKET PITCH REVISED TO LAND DRAIN	05.02.18	CD
T	DRAINAGE DITCH AROUND CRICKET PITCH DESIGNED; POND REVISED TO SUIT.	31.01.18	CD
S	PRIVATE STREET LIGHTING BOLLARDS ADDED.	12.01.18	FB
R	DRAGOUTS TO PLOTS 37–46 REVISED	05.01.18	CD
Q	TURNING HEADS FOR ROADS 3–5 REVISED	29.11.17	CD
P	FFLS PLOTS 24–28 REVISED	13.11.17	CD
N	ROAD 1 CULVERT DETAILS ADDED; TURNING HEADS REVISED IN LINE WITH VEHICLE TRACKING REQUIREMENTS	25.10.17	CD
M	FFLs REVISED TO SUIT NEW EXTERNAL LEVELS PLANS	19.09.17	CD
L	1 IN 200 YEAR WATER LEVEL NOTE ADDED TO POND; RISING MAIN SIZE REVISED, AND REDUCED DOWN TO ONE.	08.02.17	CD
K	POND WATER LEVEL AND TOP BANK LEVEL REDUCED; RISING MAIN ROUTE AND SIZE REVISED; F44 INVERT LEVEL REVISED	10.01.17	CD
J	FFL'S UPDATED TO SUIT EXTERNAL LEVELS. PRIVATE DRAINAGE ALSO UPDATED.	07.12.16	FB
H	FOUL GRADIENTS REVISED; F43–F19 PIPE REVISED TO OVAL; OTHER AMENDMENTS IN LINE WITH UU COMMENTS.	21.11.16	CD
G	PRIVATE DRAINAGE ADDED.	24.10.16	FB
F	FFL'S UPDATED TO SUIT EXTERNAL LEVELS.	20.10.16	FB
E	SECOND RISING MAIN & DIAMETERS ADDED; INCOMING INVERT REVISED.	18.10.16	CD
D	FFLs REVISED; NAME PLATES, TACTILE CROSSINGS AND STREET LIGHTS ADDED; F40 REMOVED; F39–F42 REVISED; DIVERSION ROUTE REVISED	07.10.16	FB/CD
C	REVISED IN LINE WITH NEW 1:20 MANHOLE SCHEDULES; FOUL ONLINE STORAGE ADDED; DIVERSION LEVELS ADDED	11.08.16	CD
B	FULL DRAINAGE DESIGN DUE TO OUTFALL CHANGES & POND PUT IN	06.04.16	CD
A	FULL DRAINAGE DESIGN DUE TO FLOW RATE CHANGES & POND REMOVED	23.03.16	CD

BARRATT HOMES

MANCHESTER

Barratt Homes Manchester
(A division of BDW Trading Ltd)
4 Brindley Road
City Park
Manchester
M16 9HQ
Tel: 0161 872 0161
Fax: 0161 855 2828

Job: Chipping Lane Longridge			
Title: Engineering Layout			
Design By: CD	Date: Feb 2016	Drawing Number: 459/ED/02	Rev: 34
C.A.D By: CD	Scale: 1:500 @ A0		

Street Lighting Key

6M TUBULAR STEEL LIGHTING COLUMN WITH GLASS EPOXY ROOT TREATMENT.

COLUMN TO BE FITTED WITH 1NO. POST-MOUNTED URBIS SCHREDER AXIA 3.1 16LED OLSON SQUARE GIANT 160mA S5/R2 FITTED WITH LUCY ZODION CBFSS5DR 10/10 SWITCHING FACTORY SET TO DIM @ 50% FROM 19-00HRS TO 07-00HRS.

5M TUBULAR STEEL LIGHTING COLUMN WITH GLASS EPOXY ROOT TREATMENT.

COLUMN TO BE FITTED WITH 1NO. POST-MOUNTED URBIS SCHREDER AXIA 3.1 16LED OLSON SQUARE GIANT 160mA S5/R2 FITTED WITH LUCY ZODION CBFSS5DR 10/10 SWITCHING FACTORY SET TO DIM @ 50% FROM 19-00HRS TO 07-00HRS.

6M HINGED TUBULAR STEEL LIGHTING COLUMN WITH GLASS EPOXY ROOT TREATMENT.

COLUMN TO BE FITTED WITH 1NO. POST-MOUNTED URBIS SCHREDER AXIA 3.1 8LED OLSON SQUARE GIANT 212mA S5/R1 FITTED WITH LUCY ZODION CBFSS5DR 10/10 SWITCHING FACTORY SET TO DIM @ 50% FROM 19-00HRS TO 07-00HRS.

6M HINGED TUBULAR STEEL LIGHTING COLUMN WITH GLASS EPOXY ROOT TREATMENT.

COLUMN TO BE FITTED WITH 1NO. POST-MOUNTED URBIS SCHREDER AXIA 3.1 16LED OLSON SQUARE GIANT 160mA S5/R2 FITTED WITH LUCY ZODION CBFSS5DR 10/10 SWITCHING FACTORY SET TO DIM @ 50% FROM 19-00HRS TO 07-00HRS.

EXISTING COLUMN AS PER PHASE 1 DESIGN.

LC36 COLUMN IDENTIFICATION NUMBER.

WARNING TO HOUSE-PURCHASERS

Property Misdescriptions Act 1991

Buyers are warned that this is a working drawing and is not intended to be treated as descriptive material describing, in relation to any particular property or development, any of the Specified matters prescribed by any Order made under the above Act. The contents of this drawing may be subject to change at any time and alterations and variations can occur during the progress of the works without revision of the drawing. Consequently the layout, form, content and dimensions of the finished construction may differ materially fron those shown. Nor do the contents of this drawing constitute a contract, part of any contract or warranty.

ENGINEERING LAYOUT NOTES

1. All adoptable drainage works have been designed and are to be constructed in accordance with 'Sewers for Adoption, 6th Edition', and United Utilities 'Guidelines for Sewer for adoption 6th Edition'. Where specification conflicts, UU guidelines shall take presidence.

United Utilities Standard details to be used are:

STND/19/001A	Manhole Type 1
STND/19/002A	Manhole Type 2 and Invert Access Detail
STND/19/003A	Shallow Manhole Detail for Small Diameter Pipes (Type 4)
STND/19/004A	Shallow Surface Water Manhole Detail – Restricted Headroom (less than 2.0m) – For Pipe Sizes 450Dia and Above
STND/19/005A	Flow Control Manhole Detail
STND/19/007A	External Backdrop Detail
STND/19/008A	Pipe Bedding Detail
STND/19/010A	Variable Manhole – Guidance Notes
STND/19/011A	Headwall Type 1 and Typical Outlet Grille Detail
STND/19/012A	Typical Outfall Details Type 2 & Type 3

2. All clay pipe work shall be Extra Strength Clayware to BS 295 and BS 65 (SW pipes only).

3. All precast concrete pipework shall be to Class 120 in accordance with BS5911 Part 1, BS EN 1916 and bear the BS kitemark.

4. All adoptable drainage to be bedded in Class S granular surround unless otherwise stated.

5. All Concrete manholes and Soakaways rings, Concrete cover slabs and Con to be manufactured to BS EN 1917 and BS 5911:Part 3.

6. Rising Mains to be Black Polyethylene Pipes complying to BS EN 13244-2. Polyethylene fittings, including fusion joints, and electro-fusion fittings shall comply with BS EN 13244-2.

7. All levels relate to Ordnance Datum. Contractor to ensure that this drawing is read in conjuction with the site specific Topographical Survey provided by Barratt Manchester and the Benchmark information provided.

8. This drawing is to be read in accordance with all other relevant drawings.

9. The contractor shall be responsible for ensuring that any existing invert levels indicated on the drawings are correct before work commences.

10. All proposed connections to the sewer shall be 150ø unless stated otherwise.

11. All private house drainage shall be 100ø and all drag-out connections shall be 150ø at a minimum gradient of 1:80 unless otherwise stated and laid in accordance with Part H of the the Building Regulations.

12. Runoff from private surfaces shall not discharge across the highway. Gullies or channels shall be provided as appropriate to prevent this.

13. Pram crossings shall be provided at the inner tangent points of all junctions.

14. Pipes shall be protected from concentrated loading by construction traffic during the construction period when insufficient cover to the pipe may make them vulnerable to damage.

15. Insitu CBR tests of the road formation level are to be carried out to determine the depth of pavement construction required. This is to be approved by the adopting authority prior to construction of the road pavements.

16. Groundworker to ensure that plot drainage be within the curtilage of the plot they serve where possible and inspection covers kept within hardstandings where possible.

17. Contractor to provide United Utilities with sufficient notice prior to commencement of Sewer works on their Inspections telephone number. Tel 0845 602 0406.

18. Contractor to obtain all necessary Highway opening notices from the relevant Local Authority, obtain approval to work on United Utilities Sewerage System, obtain approval to method statement from the Environment Agency for any works affecting a watercourse.

ENGINEERING KEY

S1 Adoptable S.W. Sewer & Manhole

F1 Adoptable F.W. Sewer & Manhole

Silt Trap Manhole at Overflow Basins

S1 Adoptable S.W. Sewer Headwall

(10.25) S. Water Drag-Out and Invert

10.25 Foul Drag-Out and Invert

Adoptable Road Gully

Street Name Plate

FLOW CONTROL DETAILS

MH Ref.	Specification
S110	ACO Orifice Plate to be Supplied by ACO Technologies. Tel 01462 816666. Ref: SL20190923 1No. 247mm Q-Plate-RW
S324	Crown Flow Control Device to be Supplied by Crown Water Systems. Tel 01344 886 996. Ref: 4280619 1No. 230mm QR5 Type Vortex Flow Control Unit. Head=3.20m, Flow=42.4 l/s.
S414	Crown Flow Control Device to be Supplied by Crown Water Systems. Tel 01344 886 996. Ref: 4280619 1No. 192mm QR5 Type Vortex Flow Control Unit. Head=2.6m, Flow=26.6 l/s.

REV	DESCRIPTION	DATE	DRAWN
S	Plots 118–159 & 194–198 revised to suit groundworks	25.10.21	CD
R	Plots 52–53 handed; Plots 118–156 revised; Plots 194–198 added	27.09.21	CD
Q	Revised to Planning Layout Rev 10	07.06.21	CD
P	S107–S109A revised; F102–F105 revised	26.10.20	CD
N	Housetypes, FFLs, and plot drainage revised to suit Planning Layout Rev 09, and new external levels (Sept 2020)	25.09.20	CD
M	SW downpipes revised to suit deep gutters	01.09.20	CD
L	Road 10 chainage revised to suit longsection; Road 10 raised table split into two, gullies and cover levels revised to suit; Street lighting revised	24.06.20	CD
K	S109–S110, F104–F105 revised, S109A & F104A added; S415 split into 2 headwalls, S508 added	27.02.20	CD
J	S501–S502 revised; Cover levels revised within raised tables; Tactiles revised	09.12.19	CD
H	Site lifted to reduce soil leaving site. FFLs and cover levels revised	01.11.19	CD
G	Easement from S201–S49 & F321–F23 added; Flow control units updated to Crown spec. & S110 revised to orifice plate; Pond water levels revised to suit new calcs; Existing sewer in Road 19 revised; S109 & F104 revised	06.09.19	CD
F	Street lighting and plot drainage added	25.06.19	CD
E	Gradients of SW network 2 revised; S403, S406 & F304 removed	17.04.19	CD
D	Updated to planning layout revision 5	04.03.19	CD
C	Full drainage and level designs revised	11.02.19	CD
B	–	–	–
A	Revised from Proposed FFL dwg to Engineering Layout	–	–

BARRATT
HOMES

MANCHESTER

Barratt Homes Manchester
(A division of BDW Trading Ltd)
4 Brindley Road
City Park
Manchester
M16 9HQ
Tel: 0161 872 0161
Fax: 0161 855 2828

Job: Chipping Lane, Longridge, Phases 2 & 3			
Title: Engineering Layout			
Design By: FB	Date: 15.10.18	Drawing Number: 459/ED/102	Rev: S
C.A.D By: FB	Scale @ A0: 1:500		

Phase	Developable Area (Ha)	Greenfield Runoff Rate per Hectare (l/s/Ha)	Allowable Runoff Rate (l/s)
1	4.32	8.3	35.9
2A	1.80	13.6	24.5
2B	2.69	13.6	36.6
3	1.71	13.6	23.3
		TOTAL	**120.2**

Drainage Network	Allowable Discharge Rate (l/s)	Actual Discharge Rate (l/s)
1+2A	60.3	49.9
3	36.6	41.8
4	23.3	26.4
Total	**120.2**	**118.1**

WARNING TO HOUSE-PURCHASERS
Property Misdescriptions Act 1991

Buyers are warned that this is a working drawing and is not intended to be treated as descriptive material describing, in relation to any particular property or development, any of the Specified matters prescribed by any Order made under the above Act.
The contents of this drawing may be subject to change at any time and alterations and variations can occur during the progress of the works without revision of the drawing. Consequently the layout, form, content and dimensions of the finished construction may differ materially fron those shown. Nor do the contents of this drawing constitute a contract, part of any contract or warranty.

REV	DESCRIPTION	DATE	DRAWN
A	Planning layout revised to PL06, Rev 1; Actual discharge rates revised to suit new calcs.	27.09.21	CD

BARRATT
HOMES

MANCHESTER

Barratt Homes Manchester
(A division of BDW Trading Ltd)
4 Brindley Road
City Park
Manchester
M16 9HQ
Tel: 0161 872 0161
Fax: 0161 855 2828

Job
Chipping Lane
Longridge
Phases 1, 2 & 3

Title
Developable Areas Plan

Design By	Date	Drawing Number	Rev
CD	Oct 2019	459/ED/146	A
C.A.D By: CD	Scale @ A0: 1:1000		

IMPERMEABLE AREAS	IMPERMEABLE AREAS inc. URBAN CREEP
1.000 = 0.168 Ha	1.000 = 0.185 Ha
1.005 = 0 Ha	1.005 = 0 Ha
1.006 = 0 Ha	1.006 = 0 Ha
1.009 = 0.022 Ha	1.009 = 0.024 Ha
1.011 = 0 Ha	1.011 = 0 Ha
1.012 = 0 Ha	1.012 = 0 Ha
5.002 = 0 Ha	5.002 = 0 Ha
5.003 = 0 Ha	5.003 = 0 Ha
5.008 = 0 Ha	5.008 = 0 Ha
5.010 = 0 Ha	5.010 = 0 Ha
5.021 = 0 Ha	5.021 = 0 Ha
6.003 = 0.265 Ha	6.003 = 0.291 Ha

WARNING TO HOUSE-PURCHASERS

Property Misdescriptions Act 1991

Buyers are warned that this is a working drawing and is not intended to be treated as descriptive material describing, in relation to any particular property or development, any of the Specified matters prescribed by any Order made under the above Act. The contents of this drawing may be subject to change at any time and alterations and variations can occur during the progress of the works without revision of the drawing. Consequently the layout, form, content and dimensions of the finished construction may differ materially fron those shown. Nor do the contents of this drawing constitute a contract, part of any contract or warranty.

ENGINEERING LAYOUT NOTES

1. All adoptable drainage works have been designed and are to be constructed in accordance with 'Sewers for Adoption, 6th Edition', and United Utilities 'Guidelines for Sewer for adoption 6th Edition'. Where specification conflicts, UU guidelines shall take presidence.

United Utilities Standard details to be used are:

STND/00/006B	Typical Outfall Details D, E and F
STND/00/007C	Typical Details G & H Outlet Grille and safety grille to materials access shaft
STND/01/001E	Standard Detail No 4 (Type 1 Manhole) Standard Detail No 5 (Type 2 Manhole) Standard Detail No 6 (Manhole Accesses)
STND/01/002E	Standard Details 7, 8, 9 and 10 Ladders, Safety Chains and Handrailing.
STND/01/003D	Typical Details A, B, and C External and Internal Backdrops and Connection Details
STND/01/004B	Manhole and French Drain Details MH3, MH4, MH5 and PS6
STND/01/006B	Typical Details I and J – Segmental Shafts
STND/05/001B	Pipe Embedment Details
STND/01/013B	Manhole Access Details
STND/01/015A	Shallow Large Diameter Sewer

2. All clay pipe work shall be Extra Strength Clayware to BS 295 and BS 65 (SW pipes only).

3. All precast concrete pipework shall be to Class 120 in accordance with BS5911 Part 1, BS EN 1916 and bear the BS kitemark.

4. All adoptable drainage to be bedded in Class S granular surround unless otherwise stated.

5. All Concrete manholes and Soakaways rings, Concrete cover slabs and Con to be manufactured to BS EN 1917 and BS 5911:Part 3.

6. Rising Mains to be Black Polyethylene Pipes complying to BS EN 13244–2. Polyethylene fittings, including fusion joints, and electro–fusion fittings shall comply with BS EN 13244–2.

7. All levels relate to Ordnance Datum. Contractor to ensure that this drawing is read in conjuction with the site specific Topographical Survey provided by Barratt Manchester and the Benchmark information provided.

8. This drawing is to be read in accordance with all other relevant drawings.

9. The contractor shall be responsible for ensuring that any existing invert levels indicated on the drawings are correct before work commences.

10. All proposed connections to the sewer shall be 150ø unless stated otherwise.

11. All private house drainage shall be 100ø and all drag–out connections shall be 150ø at a minimum gradient of 1:80 unless otherwise stated and laid in accordance with Part H of the the Building Regulations.

12. Runoff from private surfaces shall not discharge across the highway. Gullies or channels shall be provided as appropriate to prevent this.

13. Pram crossings shall be provided at the inner tangent points of all junctions.

14. Pipes shall be protected from concentrated loading by construction traffic during the construction period when insufficient cover to the pipe may make them vulnerable to damage.

15. Insitu CBR tests of the road formation level are to be carried out to determine the depth of pavement construction required. This is to be approved by the adopting authority prior to construction of the road pavements.

16. Groundworker to ensure that plot drainage be within the curtilage of the plot they serve where possible and inspection covers kept within hardstandings where possible.

17. Contractor to provide United Utilities with sufficient notice prior to commencement of Sewer works on their Inspections telephone number. Tel 0845 602 0406.

18. Contractor to obtain all necessary Highway opening notices from the relevant Local Authority, obtain approval to work on United Utilities Sewerage System, obtain approval to method statement from the Environment Agency for any works affecting a watercourse.

19. All manholes adopted by TMBC to have a minimum 150mm ST4 concrete surround to full depth.

REV	DESCRIPTION	DATE	DRAWN
C	URBAN CREEP ADDED TO DRAINAGE AREAS	04.12.19	CD
B	REVISED IN LINE WITH ENGINEERING LAYOUT REV C	18.07.16	CD
A	FULL DRAINAGE DESIGN DUE TO FLOW RATE CHANGES & POND REMOVED	24.03.16	CD

BARRATT HOMES

MANCHESTER

Barratt Homes Manchester
(A division of BDW Trading Ltd)
4 Brindley Road
City Park
Manchester
M16 9HQ
Tel: 0161 872 0161
Fax: 0161 855 2828

Job: Chipping Lane, Longridge

Title: Surface Water Drainage Area Plan

Design By	Date	Drawing Number	Rev
CD	Feb 2016	459/ED/04	C
C.A.D By: CD	Scale: 1:500 @ A0		

WARNING TO HOUSE-PURCHASERS
Property Misdescriptions Act 1991

Buyers are warned that this is a working drawing and is not intended to be treated as descriptive material describing, in relation to any particular property or development, any of the Specified matters prescribed by any Order made under the above Act.
The contents of this drawing may be subject to change at any time and alterations and variations can occur during the progress of the works without revision of the drawing. Consequently the layout, form, content and dimensions of the finished construction may differ materially fron those shown. Nor do the contents of this drawing constitute a contract, part of any contract or warranty.

Impermeable Areas	Impermeable Areas + 10% Urban Creep to Domestic Property
1-1.000 = 0.033 Ha of Highway 0.045 Ha of Domestic Property	1-1.000 = 0.033 Ha of Highway 0.050 Ha of Domestic Property
1-1.001 = 0.022 Ha of Highway 0.059 Ha of Domestic Property	1-1.001 = 0.022 Ha of Highway 0.065 Ha of Domestic Property
1-1.004 = 0.030 Ha of Highway 0.057 Ha of Domestic Property	1-1.004 = 0.030 Ha of Highway 0.063 Ha of Domestic Property
2-1.000 = 0.035 Ha of Highway 0.047 Ha of Domestic Property	2-1.000 = 0.035 Ha of Highway 0.052 Ha of Domestic Property
3-1.011 = 0 Ha	3-1.011 = 0 Ha
3-1.014 = 0 Ha	3-1.014 = 0 Ha
4-1.000 = 0.052 Ha of Highway 0 Ha of Domestic Property	4-1.000 = 0.052 Ha of Highway 0 Ha of Domestic Property
4-1.004 = 0 Ha of Highway 0.042 Ha of Domestic Property	4-1.004 = 0 Ha of Highway 0.046 Ha of Domestic Property
4-1.005 = 0.054 Ha of Highway 0 Ha of Domestic Property	4-1.005 = 0.054 Ha of Highway 0 Ha of Domestic Property
4-1.008 = 0 Ha	4-1.008 = 0 Ha
4-2.000 = 0.061 Ha of Highway 0.083 Ha of Domestic Property	4-2.000 = 0.061 Ha of Highway 0.091 Ha of Domestic Property
4-3.000 = 0.015 Ha of Highway 0 Ha of Domestic Property	4-3.000 = 0.015 Ha of Highway 0 Ha of Domestic Property

REV	DESCRIPTION	DATE	DRAWN
B	Plots 118–156 revised; Plots 194–198 added	27.09.21	CD
A	Plots 42–43 drives revised; Road 10 raised table revised, gullies moved to suit	24.06.20	CD

BARRATT
HOMES

MANCHESTER

Barratt Homes Manchester
(A division of BDW Trading Ltd)
4 Brindley Road
City Park
Manchester
M16 9HQ
Tel: 0161 872 0161
Fax: 0161 855 2826

Job
Chipping Lane
Longridge
Phases 2 & 3

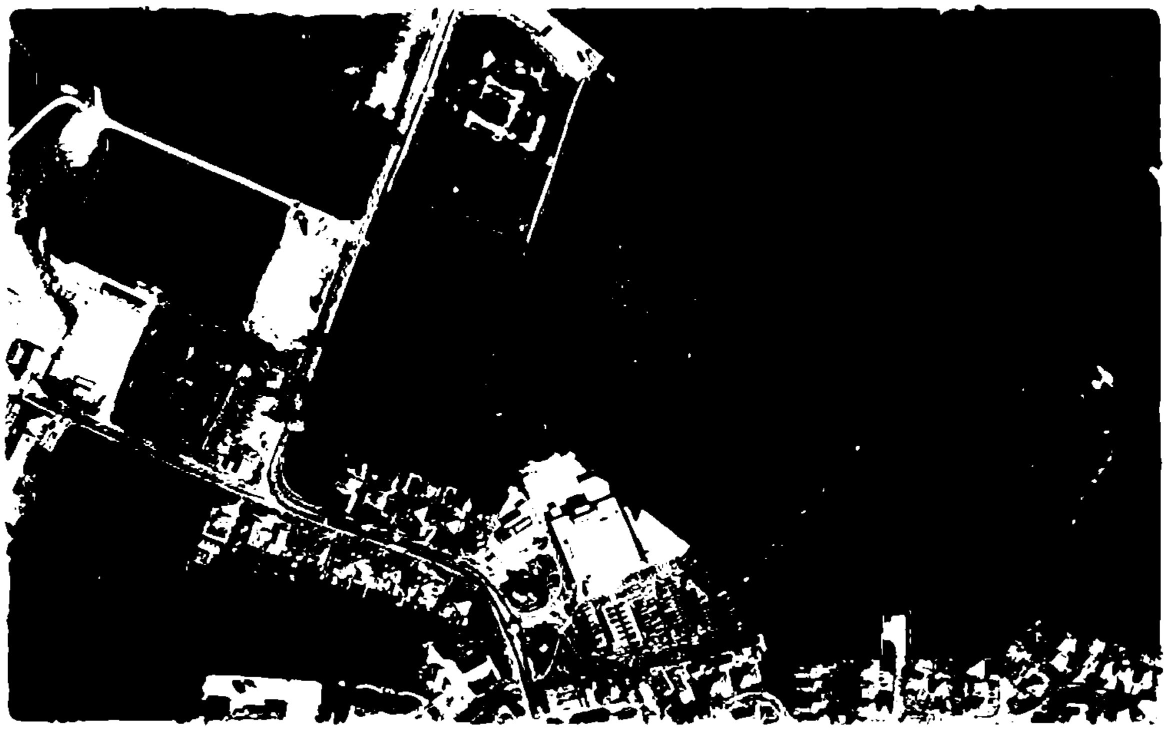
Title
Surface Water Drainage Areas

Design By	Date	Drawing Number	Rev
CD	April 2019	459/ED/103	B
C.A.D By: CD	Scale @ A0: 1:500		

CONSULTING ENGINEERS

Chipping Lane, Longridge

FLOOD RISK ASSESSMENT
& SUSTAINABLE DRAINAGE ASSESSMENT



For

Barratt Homes
BDW Trading Limited
Barratt House, Cartwright Way,
Forest Business Park, Bardon Hill,
Coalville,
Leicestershire,
LE67 1UF

BARRATT

March 2016

CONSULTING ENGINEERS

Chipping Lane, Longridge
FLOOD RISK ASSESSMENT
& SUSTAINABLE DRAINAGE ASSESSMENT

Document Tracking Sheet

Document Reference: HYD068
Revision: 2.1
Date of Issue: 3rd March 2016
Report Status: Final

Prepared by: [redacted] BSc (*Hons*), FdSc
Flood Risk Analyst

[redacted]
Engineering Technician

Checked by: [redacted] BSc (Hons) CEng MIStructE
Managing Director

Authorised by [redacted] BEng (Hons) MBA
Director

Revision History:

Rev:	Date:	Status:	Prepared by:	Checked by:	Issued by:
1.0	09/02/2016	Draft	HJ/CP	RDN/RMF	HJ
1.1	22/02/2016	Draft	HJ/CP	RDN/RMF	HJ
2.0	03/03/2016	Final	HJ/CP	RDN/RMF	HJ
2.1	03/03/2016	Final	HJ/CP	RDN/RMF	HJ

EXECUTIVE SUMMARY

This Flood Risk Assessment (FRA) & Sustainable Drainage Assessment has been prepared for a proposed **residential development** and associated infrastructure located at **Chipping Lane, Longridge**. The site is located within **Flood Zone 1** according to the Environment Agency's (EA's) online flood maps. The National Planning Policy Framework (NPPF) requires a FRA for sites greater than 1 ha. The proposals are 'residential' in nature, classified as 'more vulnerable' in Table 2 within the Technical Guidance to the NPPF. This type of development is appropriate in Flood Zone 1.

This FRA has identified the site to be at **low risk** from all sources of flooding including; fluvial, tidal, pluvial, groundwater, sewer related and flooding from artificial sources. The development is accessible during times of extreme flooding as the site is within Flood Zone 1.

The development proposal was granted outline planning application (N° 3/2014/0764) on the 29th October 2015. This FRA has built upon the FRA submitted with the application completed by RSK (March 2015, Ref: 880500-R1). The previous FRA proposed that run-off rates will be restricted to QBar. In this report, **QBar** is calculated as **8.3 l/s/ha**. See Appendix C for Hydrological Calculations. Any discrepancy between this QBar and the previous figure is due to refined FEH catchment characteristics being utilised within the ICP SuDS method.

The existing site is classed as greenfield. Surface water runoff from the existing site flows overland in a north-westerly direction before outfalling to a land drainage ditch/ordinary watercourse situated along the northern border. This ditch flows west before outfalling via a 600mm dia pipe to contribute to the Higgin Brook catchment.

The ground investigation report carried out by Soiltechnics (Feb 2016, Ref: STN3505NM-G01) indicates that infiltration is **not viable** at this site.

Surface water will outfall via the existing pathways (i.e. to the on-site ordinary watercourse) at a maximum rate of QBar (l/s). The restriction of runoff rates on increased impermeable areas will create storm water storage volumes. These will be retained on-site for events up to and including the 1 in 100 year event plus an allowance for climate change. Sustainable Drainage Systems (SuDS) could be incorporated into the planning layout which will assist in the reduction of surface water runoff from areas of hardstanding.

The nearest public foul sewers are located within Inglewhite Road to the south-east of the site. The conveyance route of foul flows will be determined during detailed design. A pumped solution will likely be required and early liaisons with UU regarding adoptable pump design are recommended.

CONSULTING ENGINEERS

CONTENTS

Figures & Tables

Specialist Software

- Flood Estimation Handbook FEH CD-ROM (v.3.0) – Determination of Catchment Descriptors and depths of rainfall.
- MicroDrainage WinDES (v.14.1) – Calculation of Greenfield run-off rates IH124/ICP-SUDS, Greenfield run-off volumes, rates of rainfall and stormwater storage estimates.

Abbreviations & Acronyms

AEP	Annual Exceedance Probability	mAOD	Metres Above Ordnance Datum
BGL	Below Ground Level	NGR	National Grid Reference
BGS	British Geological Survey	NPPF	National Planning Policy Framework
CC	Climate Change	NSRI	National Soil Resources Institute
EA	Environment Agency	OS	Ordnance Survey
FEH	Flood Estimation Handbook	PFRA	Preliminary Flood Risk Assessment
FRA	Flood Risk Assessment	PPS	Planning Policy Statement
FZ	Flood Zone	QSE	Quick Storage Estimate
Ha	Hectare	QBAR	Mean Annual Flood
IDB	Internal Drainage Board	SFRA	Strategic Flood Risk Assessment
LLFA	Lead Local Flood Authority	SuDS	Sustainable Drainage Systems
LPA	Local Planning Authority	UU	United Utilities

1.0 INTRODUCTION

1.1.1 The impact of flooding on the natural and built environment are material planning considerations. The NPPF sets out the Government's objectives for the planning system, how planning should facilitate and promote sustainable patterns of development, avoiding flood risk and accommodating the impacts of climate change. Government policy with respect to development in flood risk areas is contained within the NPPF and the supporting Technical Guidance.

1.1.2 The NPPF requires a FRA for sites greater than 1 ha. The proposals are 'residential' in nature, classified as 'more vulnerable' in Table 2 within the Technical Guidance to the NPPF. This type of development is appropriate in Flood Zone 1.

1.1.3 The development proposal was granted outline planning application (N° 3/2014/0764) on the 29th October 2015. This FRA has built upon the FRA submitted with the application completed by RSK (March 2015, Ref: 880500-R1).

1.1.4 The NPPF advises that the LPA should consult with the EA for advice on flood issues at a strategic level and in relation to planning applications.

2.0 EXISTING SITE LOCATION

2.1 Location

2.1.1 The site is located on land off Chipping Lane, Longridge, PR3 2NA. The OS NGR is 360073E, 437980N.

2.1.2 The site is surrounded by greenfield land to the north, east and west and by residential areas to the south. Chipping Lane forms the western site boundary.

2.2 Existing and Historical Land Use

2.2.1 The site is currently classed as greenfield. No other land uses have been identified as part of this report.

2.3 Topography

2.3.1 The site slopes in a north-westerly direction with levels ranging from around 121m AOD near the eastern border to 102m AOD in the north-west.

3.0 DEVELOPMENT PROPOSALS

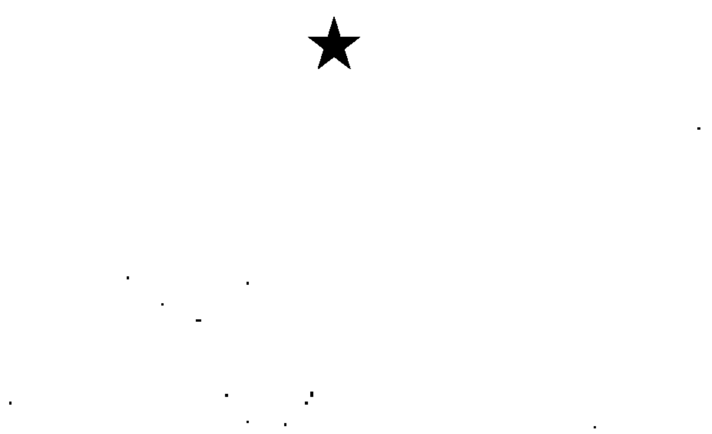
3.1 Nature of the development

3.1.1 The nature of the development is residential and comprises of residential units associated infrastructure. A copy of the development layout for Phase I is included in Appendix A.

4.0 SOURCES OF FLOOD RISK

4.1 Fluvial Flood Risk

4.1.1 The flood risk of the site has been assessed using EA online Flood Maps.



- ☐ Flood Zone 1 – Low Risk (<0.1%)
- ☐ Flood Zone 2 – Medium Risk (1% – 0.1% fluvial, 0.5% – 0.1% tidal)
- ☐ Flood Zone 3 – High Risk (>1% fluvial, >0.5% tidal)

Figure 1: EA Flood Map for Planning (Rivers and Sea).

4.1.2 Figure 1 shows that the site is within Flood Zone 1, which would indicate a **low risk** from fluvial flooding.

4.2 Tidal Flooding

4.2.1 As there is no coastline or tidal river near to the site, tidal flood risk is deemed **low.**

4.3 Pluvial Flood Risk

4.3.1 Pluvial (surface water) flooding occurs when rainwater is unable to drain away through the normal drainage systems or soak into the ground, but lies on or flows over the ground instead.

4.3.2 Pluvial flood risk as indicated by the EA map (Figure 2) shows that the site is predominantly at **very low** to **low** risk.

Very low risk (<0.1%)
Low risk (0.1% - 1%)
Medium risk (1% - 3.3%)
■ High risk (>3.3%)

Figure 2: The EA's Indicative Surface Water Flood Risk Map.

4.3.3 There are some areas of low to medium risk that appear to follow the direction of overland flow. There is a singular area of medium to high risk located centrally to the site that is indicative of a topographic low point.

4.3.4 The development proposals, although increasing the impermeable area of the site, will provide a betterment on the pre-existing scenario in that any exceedance flows for storm events up to and including the 100 year event plus 30% climate change, will be attenuated on-site prior to a restricted outfall.

4.3.5 Finished floor levels will be raised at least 150mm above the external levels and external areas of hardstanding will comply with building regulations and divert water away from the proposed dwellings. This will further mitigate pluvial flood risk.

4.3.6 Therefore the pluvial flood risk to the development is overall considered to be **low.**

4.4 Sewer Related Flood Risk

4.4.1 Rainwater is sometimes drained into combined sewers. Foul water flooding can occur in areas prone to overland flow when the sewer is overwhelmed by heavy rainfall and will continue until the water drains away. It can also occur when the sewer becomes blocked or is of inadequate capacity, this could lead to there being a high risk of internal property flooding with contaminated water.

4.4.2 United Utilities records indicate that there is a 375mm diameter surface water pipe from the eastern site boundary which cuts through the site before outfalling to Higgin Brook near the centre of the site. A 3m easement will apply from this SWS in accordance with UU guidelines.

4.4.3 New sewers will be designed and constructed in accordance with Sewers for Adoption and put up for adoption by United Utilities as part of the detailed design (stc).

4.4.4 Flood Risk from sewer related sources is considered to be **low**. See Appendix B for UU sewer records.

4.5 Groundwater Flood Risk

4.5.1 In general terms groundwater flooding can occur from three main sources: - raised water tables, seepage and percolation and groundwater recovery or rebound.

- If groundwater levels are naturally close to the surface then this can present a flood risk during times of intense rainfall.
- Seepage and percolation occur where embankments above ground level hold water. In these cases water travels through the embankment material and emerges on the opposite side of the embankment.
- Groundwater recovery/rebound occurs where the water table has been artificially depressed by abstraction. When the abstraction stops the water table makes a recovery to its original level. There is the potential for groundwater flooding in low lying areas where groundwater levels have been depressed below their pre-pumping conditions, where these were at or close to ground level.

4.5.2 The online BGS maps show that the underlying geology consists of the Bowland Shale Formation, whilst the Soilscapes online Map indicates that the soil has impeded drainage. The presence of surface water flood lines in the direction of overland flow in Figure 2 is also indicative of the presence of poorly permeable underlying clay soils.

4.5.3 Groundwater flood risk is therefore considered to be **'low'**, this will be further mitigated by the increase in Finished Floor Levels by at least 150mm above existing external levels.

4.6 Artificial Sources of Flood Risk

4.6.1 The site is partially at risk of flooding from the 'Dilworth Upper' reservoir, yet the risk designation is yet 'to be determined' according to the EA online maps and information. Reservoir flooding is extremely rare, therefore the flood risk from artificial sources is deemed **low.**

4.7 Flood Risk Mitigation Measures & Residual Risks

4.7.1 Finished Floor Levels will be a minimum of 150mm above the external levels (following any re-grade). External levels within proximity will fall away from proposed dwellings in accordance with building regulations.

4.7.2 Surface water run-off rates will be restricted through the use of vortex flow control devices. The increased volume of run-off for storms greater than the 30 year event can be mitigated through the use of SuDS (evapotranspiration/bio-retention/rainwater re-use).

4.7.3 The development is considered accessible during the extreme storm events as the site is within Flood Zone 1.

5.0 SURFACE WATER MANAGEMENT

5.1 Pre-Development Surface Water Run-off

5.1.1 The previous FRA completed by RSK (March 2015, Ref: 880500-R1) proposed that run-off rates will be restricted to QBar. In this report, QBar is calculated as 8.3 l/s/ha. See Appendix C for Hydrological Calculations. Any discrepancy between this QBar and the previous figure is due to refined FEH catchment characteristics being utilised within the ICP SuDS method.

5.1.2 The pre-development (greenfield) runoff rates are shown in Table 1. The ICP SuDS method was utilised using FEH catchment characteristics.

Storm Event	Greenfield Rate (l/s/ha)
Q1 year	7.2
QBar	8.3
Q30 years	14.0
Q100 years	17.2

Table 1: Greenfield Run-off Rates (ICP SuDS)

5.2 Post-Development Surface Water Run-off

5.2.1 The impermeable area will increase as a result of the development and increased run-off rates will be restricted to QBar (l/s/ha) thereby providing **significant betterment** to the downstream catchment for all storm events greater than the average annual event.

5.2.2 Rates will be restricted through the use of a vortex flow control device. Increased run-off volumes for storms greater than the 30 year event can be reduced through the use of SuDS (evapotranspiration/bio-retention/rainwater reuse).

5.2.3 Storm-water storage volumes will be attenuated on-site prior to outfall. Table 2 indicates the estimated volumes of storm-water storage that will be required if flows are restricted to variable discharge rates.

5.2.4 The impermeable area is estimated to be 60% of the total site area. This is a conservative estimation that considers gardens, permeable driveways and landscaped areas.

Storm Event	Storage Estimate (m^3/ha)
Q1 year	32 – 73
QBar (~ 2.3 years)	45 - 96
Q30 years	141 – 249
Q100 years + cc	327 - 507

Table 2: Quick Storage Estimates

5.2.5 Hydrological Calculations are included within Appendix C. The above figures are estimates only and will be recalculated during detailed design.

5.3 Sustainable Drainage Systems (SuDS)

5.3.1 In accordance with the NPPF, SuDS should be used wherever possible to manage surface water and reduce the impact on downstream watercourses and sewers.

5.3.2 SuDS have the ability to address four core objectives; water quantity, water quality, amenity and biodiversity. With the appropriate system specified, all four core objectives can be satisfied. Where possible, peak surface water discharge rates to watercourses and sewers should be reduced.

5.3.3 Preference should always be given to practical SuDS over conventional pipe systems. Opportunities should be taken to provide soft landscaping on site to minimise surface water run-off, improve bio-diversity and increase visual enhancement.

5.3.4 The ground investigation report carried out by Soiltechnics (Feb 2016, Ref: STN3505NM-G01) indicates that infiltration is **not viable** at this site.

5.3.5 There is potential to utilise SuDS on this site, with large areas of POS provided within the layout at the lowest points of the site. Due to the level gradient of the site, shallow SuDS would be preferable to systems such as deep ponds or detention basins. Suitable SuDS would include the use of swales and bio-retention areas.

5.3.7 It is important that SuDS is seen as a multi-use commodity, and that areas that benefit from SuDS, and the additional environmental and aesthetic enhancement they can bring if designed properly, are open to the public.

5.4 Methods of Surface Water Management

5.4.1 There are three methods that have been reviewed for the management and discharge of surface water detailed below; these may be applied individually or collectively to form a complete strategy. They should be applied in the order of priority listed below.

5.4.2 **Discharge via Infiltration** - The ground investigation report carried out by Soiltechnics (Feb 2016, Ref: STN3505NM-G01) indicates that infiltration is **not viable** at this site.

5.4.3 **Discharge to Watercourse** – There are several on-site watercourses which the site currently drains to. These are designated 'ordinary watercourses' and ordinary watercourse consent should be applied for with Lancashire County Council prior to any on-site works. As the watercourses are not designated as 'Main River', a 3-5m easement is considered appropriate.

5.4.4 **Discharge to Public Sewer** – Surface water will not outfall to a public sewer.

5.5 Climate Change

5.5.1 The UK climate is changing significantly will vary greatly by region with more short duration and high intensity rainfall events as well as more periods of long duration rainfall.

5.5.2 The NPPF Technical Guidance states that the recommended national precautionary sensitivity ranges for increase of peak rainfall intensity is 30% until 2115. The impact of climate change means there is likely to be a long term increase in average sea levels.

5.5.3 An increase in flood water levels means that flooding events will occur more frequently and have a greater impact. Any increase flood risk to the site from climate change is likely to be related to the increase in rainfall intensity and duration.

5.5.4 An additional 30% to accommodate climate change will be incorporated into the design of the stormwater storage attenuation.

5.6 Foul Water Management

5.6.1 The nearest public foul sewers are located within Inglewhite Road to the south-east of the site. The conveyance route of foul flows will be determined during detailed design. A pumped solution will likely be required and early liaisons with UU regarding adoptable pump design are recommended. Sewers will be designed and constructed in accordance with Sewers for Adoption.

6.0 SUMMARY

6.1 Conclusion and Recommendations

6.1.1 This report has been prepared for a development proposal of residential dwellings and associated infrastructure. The site lies within Flood Zone 1. The residential proposals are classified as 'more vulnerable'. This type of development is considered to be appropriate in accordance with the NPPF.

6.1.2 The report has indicated that the site is at **low** risk of flooding from fluvial, tidal, sewer related and artificial sources. There is some medium indicative risk of pluvial flooding which will be reduced and mitigated by the implementation of the development proposal. Flood risk to the surrounding area as a result of the development will be significantly reduced due to the restriction of proposed run-off rates to mimic the existing rate for the average annual event (QBar).

6.1.3 Attenuation will be provided on-site for storm events up to and including the 1 in 100 year event + 30% climate change.

6.1.4 Any residual or unforeseen flood risk to the proposed development will be further mitigated by raising finished floor levels to at least 150mm above external levels. External levels will fall away from dwellings in accordance with Building Regulations.

6.1.5 Applications for sewer adoption will be discussed and submitted during detailed design.

CONSULTING ENGINEERS

BIBLIOGRAPHY & REFERENCES

CIRIA 522: Sustainable urban drainage systems – design manual for England and Wales (2000).
CIRIA 523: Sustainable urban drainage systems – best practice manual (2001).
CIRIA 609: Sustainable drainage systems. Hydraulic, structural and water quality advice (2004).
CIRIA 624: Development and flood risk – guidance for the construction industry (2004).
CIRIA 635: Designing for Exceedance in urban drainage: Good practice (2006).
CIRIA 644: Building Greener (2007).
CIRIA 753: The SUDS manual (2015).
Flood Risk to People – Phase 2 (FD2321/TR2), DEFRA and the Environment Agency (2006).
Flood estimation for small catchments: Institute of Hydrology Report No.124, NERC (1994).
Flood Estimation Handbook, Centre for Ecology and Hydrology (1999).
Planning Policy Statement 25: Development and Flood Risk (2006).
Sewers for Adoption 7th Edition, WRc (2012).
Technical Guidance to the National Planning Policy Framework, CLG (2012).

Web-based References

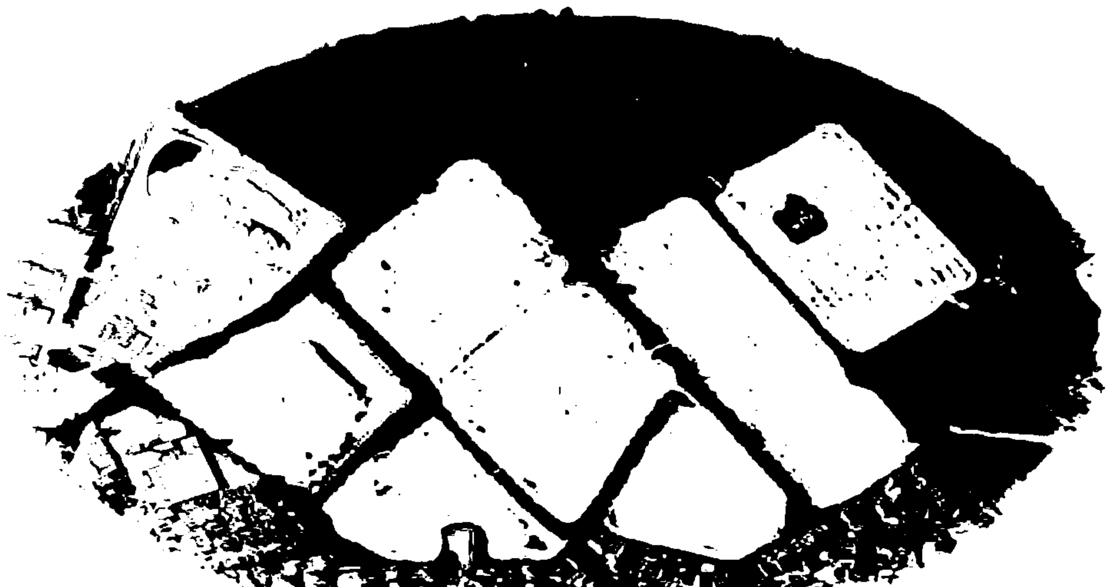
Bingmaps –www.bing.com/Maps
British Geological Survey – www.bgs.ac.uk/opengeoscience/home.html
CIRIA –www.ciria.org
Cranfield University – www.landis.org.uk/soilscapes
Environment Agency – www.environment-agency.gov.uk
Flood Forum –www.floodforum.org.uk
Google Maps – www.maps.google.co.uk
Streetmap – www.streetmap.co.uk

Appendix B
Flood Risk Assessment Phase 2 & 3

CONSULTING ENGINEERS

LAND OFF CHIPPING LANE
PHASE 2 & 3
LONGRIDGE

FLOOD RISK ASSESSMENT AND DRAINAGE MANAGEMENT STRATEGY



For

Barratt Homes Manchester
4 Brindley Road,
City Park,
Manchester,
M16 9HQ

BARRATT HOMES

NOVEMBER 2021

LAND OFF CHIPPING LANE
PHASE 2 & 3
LONGRIDGE

FLOOD RISK ASSESSMENT AND
DRAINAGE MANAGEMENT STRATEGY

Document Tracking Sheet

Document Reference: HYD371_CHIPPING.LANE_FRA&DMS
Revision: 2.0
Date of Issue: 22ND NOVEMBER 2021
Report Status: FINAL

Prepared by: [redacted]
[redacted] *BSc (Hons)*
Graduate Flood Risk Analyst

Checked by: [redacted]
[redacted] *BSc (Hons) MCIWEM*
Flood Risk Analyst

Authorised by: [redacted]
[redacted] *BEng (Hons) MSc MBA GMICE MCIWEM*
Director

Revision History:

Rev:	**Date:**	**Status:**	**Prepared by:**	**Checked by:**	**Issued by:**
2.0	22.11.2021	FINAL	HB	MB	HB
1.0	05.12.2018	FINAL	MB	DK	MB
0	20.11.2018	DRAFT	MB	DK	MB

EXECUTIVE SUMMARY

This Flood Risk Assessment and Drainage Management Strategy was commissioned by Barratt Homes referred to hereafter as 'the client'. This report has been prepared to support a full planning application for the construction of residential development on land to the east of Chipping Lane in Longridge. Phase 1 has planning approval (Ref: 3/2014/0764) and is supported by a separate, approved Flood Risk Assessment and Drainage Management Strategy (HYD068_CHIPPING.LANE_FRA&DMS).

This assessment therefore focuses on the residential development proposed as part of Phase 2 & 3 only. Phase 2 & 3 collectively cover 10.66ha, although the proposed development area covers a smaller portion at 6.24ha.

Flood Risk

The site is located wholly within Flood Zone 1 based on the Environment Agency Flood Map for Planning. The proposals are for a residential-led development, which is considered 'More Vulnerable' in Table 2: Flood Risk Vulnerability Classification within Planning Practice Guidance. This 'More Vulnerable' development is confirmed to be appropriate within Flood Zone 1, providing there is no increase in flood risk elsewhere due to the proposals.

Consultations with the Environment Agency, Ribble Valley Borough Council, Lancashire County Council and United Utilities have been undertaken and did not identify any historical incidents of flooding to the site or within the neighbouring areas. This assessment has considered all sources of flood risk. As part of Phase 1, hydraulic modelling of the Ordinary Watercourse was undertaken to determine the potential flow risks associated with the proposed culverting the Ordinary Watercourse for vehicular crossing as part of Phase 1. The full Hydraulic Assessment has been appended to this assessment for full details. To summarise the proposed Phase 2 & 3 development area will, following the implementation of mitigation measures remain flood free in all key storm events, including the 1 in 100-year (1% AEP) plus Climate Change event without having any impact on the neighbouring land/properties.

The primary source of flood risk is considered to be from surface water where the risk varies across the site from 'very low' to 'high' within the natural low-lying areas of site. The risks post-development from surface water will be effectively managed through implementation of the mitigation measures proposed within this assessment. To minimise flood risk from surface water it would also be recommended that natural drainage routes through the site be maintained within the proposals, including the existing Ordinary Watercourse, crossing the site from the southern boundary to the north.

Drainage Strategy

To ensure surface water flood risk to others does not increase, it is important to ensure surface water run-off is appropriately managed in accordance with the sustainable drainage hierarchy. Based on the ground conditions identified by the published online datasets, infiltration is not considered to provide a viable drainage solution for the development due to the impermeable strata. A ground investigation report (Ref: STN3505NM-G01) was also undertaken for Phase 1 and identified soakaways were not suitable to be used as a method for managing surface water run-off.

Assuming infiltration is not feasible, the next method in the drainage hierarchy should be discharge to a watercourse. Most of the site naturally drains to the Ordinary Watercourse crossing the site at present and the proposals are therefore to mimic the existing situation, discharging surface water run-off from the site to the watercourse using the existing onsite features where practical. Detailed design will need to confirm feasibility of a site wide gravity solution, although this is anticipated as most of the site naturally drains in this manner at present.

In accordance with the SuDS Manual and the Non-Statutory Technical Standards for Sustainable Drainage Systems, all sites should endeavour to achieve as close to pre-development greenfield rates as viable. The proposals are to therefore discharge to the watercourse crossing the site mimicking pre-development greenfield situation, QBar is calculated to be 84.9l/s and will need to be proportioned between the multiple proposed points of outfall.

Restricting the discharge rates will generate a storage requirement during extreme storm events, this will need to be considered in terms of onsite attenuation as part of detailed design. It would be beneficial to implement SuDS features at the outfall location(s) such as ponds or basins for attenuation, conveyance and water quality benefits, although this will need to be considered during detailed design.

This Flood Risk Assessment and Drainage Management Strategy has been prepared in consultation with the relevant interested parties and incorporates their comments where possible. The report is considered to be commensurate with the scale and nature of the development proposals and in summary, the development can be considered appropriate in accordance with the Planning Practice Guidance.

CONTENTS

Figures & Tables

Specialist Software

- MicroDrainage WinDES (v.14.1) – Calculation of Greenfield run-off rates IH124/ICP-SUDS, Greenfield run-off volumes, rates of rainfall and stormwater storage estimates.
- Flood Estimation Handbook FEH – Determination of Catchment Descriptors and depths of rainfall.

Abbreviations & Acronyms

AEP	Annual Exceedance Probability
BGL	Below Ground Level
BGS	British Geological Survey
CC	Climate Change
CSAI	Cranfield Soil and Agrifood Institute
EA	Environment Agency
FEH	Flood Estimation Handbook
FRA	Flood Risk Assessment
LCC	Lancashire County Council
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
mAOD	Metres Above Ordnance Datum
NGR	National Grid Reference
NPPF	National Planning Policy Framework
NSRI	National Soil Resources Institute
OS	Ordnance Survey
PFRA	Preliminary Flood Risk Assessment
PPG	Planning Practice Guidance
QSE	Quick Storage Estimate
QBAR	Mean Annual Flood
RVBC	Ribble Valley Borough Council
SfA	Sewers for Adoption
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems
TWL	Top Water Level
UU	United Utilities

1.0 INTRODUCTION

1.1 Planning Policy Context

1.1.1 All forms of flooding and their impact on the natural and built environment are material planning considerations. The revised National Planning Policy Framework (NPPF) sets out the Government's objectives for the planning system, and how planning should facilitate and promote sustainable patterns of development, avoiding flood risk and accommodating the impacts of climate change. Government policy with respect to development in flood risk areas is contained within the revised NPPF and the supporting Planning Practice Guidance (PPG) (refer to extracts in **Appendix A**).

1.1.2 A Flood Risk Assessment and Drainage Management Strategy (FRA&DMS) has been completed in accordance with the revised NPPF and the PPG to review all sources of flood risk both to and from the proposed development. The report also considers the most appropriate drainage options including the implementation of Sustainable Drainage Systems (SuDS) in line with national policy.

1.1.3 The proposals are considered to be predominantly 'residential' in nature and as such is classified as 'More Vulnerable' in Table 2: Flood Risk Vulnerability Classification, within the Planning Practice Guidance. The PPG confirms that this type of land use is appropriate for Flood Zone 1, providing there is no increase in flood risk elsewhere due to the proposals.

1.2 Site Context

1.2.1 This FRA&DMS has been prepared to support a full planning application for Phase 2 & 3 of the residential-led development, on land to the east of Chipping Lane in Longridge. This assessment is to support Phase 2 & 3 of the wider/residential-led scheme, Phase 2 and 3 will comprise of 198no. residential dwellings collectively with some land allocated for a new school. Phase 1 (for 363no. residential dwellings) already has planning approval (Ref: 3/2014/0764) and is supported by a separate, approved FRA&DMS (Ref: HYD068_CHIPPING.LANE_FRA&DMS).

1.3 Consultation

1.3.1 The preparation of this report has been undertaken in consultations with the following interested parties; the Environment Agency (EA), United Utilities (UU), Lancashire County Council (LCC) and Ribble Valley Borough Council (RVBC). Consultation responses can be seen in **Appendix B, C** and **D**. The NPPF advises that the LPA should consult with the EA who will provide advice and guidance on flood issues at a strategic level and in relation to planning applications.

2.0 EXISTING SITE LOCATION

2.1 Location

2.1.1 The proposed development site will be access via the access road for Phase 1 from Chipping Lane to the west. The Ordnance Survey National Grid Reference (OS NGR) for the site is E: 360405, N: 437794 and the nearest postcode is PR3 3HB (see Location Plan in **Appendix E**). Phase 1 of the wider scheme already has planning approval and is highlighted by the green line in **Figure 1**. This assessment however focuses on Phase 2 & 3 only, which is referred to as 'the site' and is outlined in red in **Figure 1**.

2.1.2 The total site area covers 10.66ha, although when the proposed public open space, recreational areas and the land allocated for the new school are considered, the actual residential development area will cover 6.24ha. The site is bounded to the north and east by undeveloped agricultural land and to the south lies residential dwellings off Redwood Dive. Phase 1 is located to the west of the site with neighbouring residential development, the site will also be accessed from the west through Phase 1.

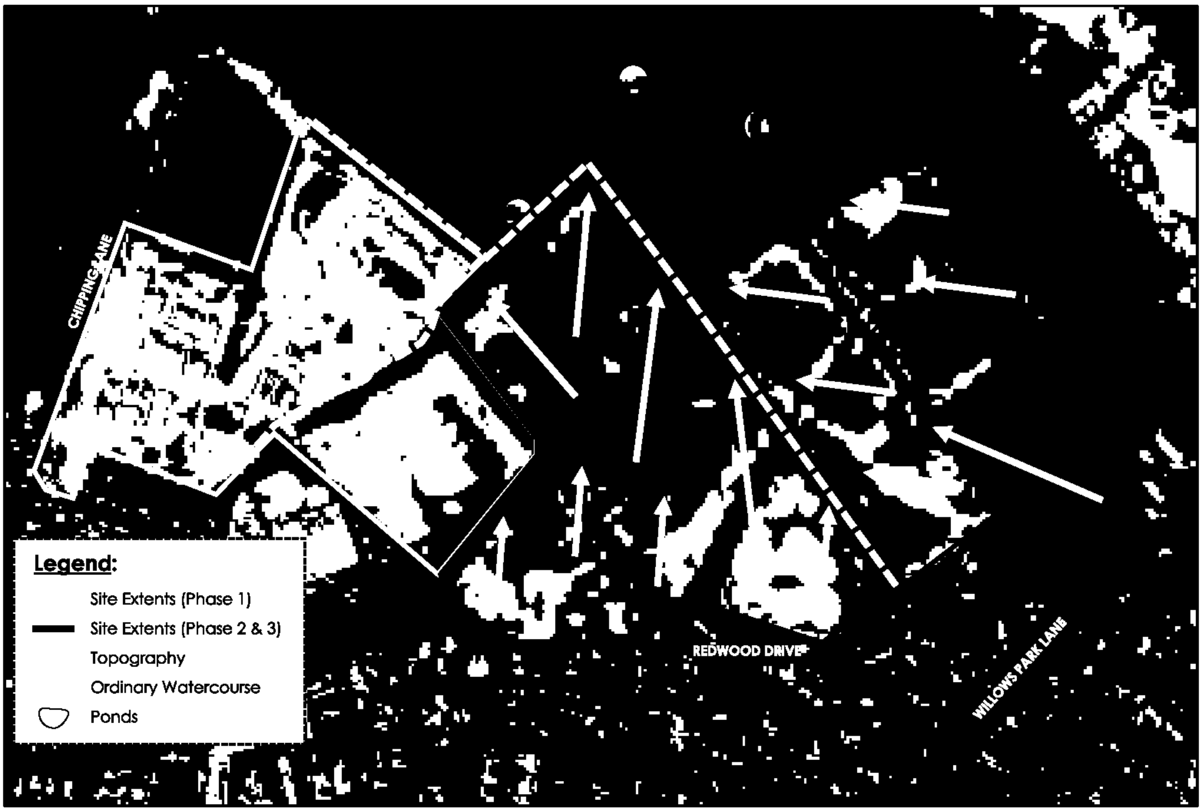


Figure 1: Aerial Photograph of site (Bing Maps, 2018)

2.2 Existing and Historical Land Use

2.2.1 The preparation of this report has identified that the site is currently undeveloped agricultural land to the east of Chipping Lane in Longridge. The site comprises of low-density vegetation with taller shrubs along some field boundaries. There are existing onsite drainage features present including the Ordinary Watercourse flowing north into Higgin Brook. Historically the site was utilised for agricultural purposes and no other historical land uses have been determined during the preparation of this report.

2.3 Topography

2.3.1 The topographic levels naturally vary onsite given the land-use. The site generally falls towards the Ordinary Watercourse flowing adjacent to the northern field boundary and to the Ordinary Watercourse crossing the site. There is an overall fall from 121.50mAOD in the south to 106.41mAOD in the north. A full topographical survey has been carried out and is included in **Appendix F.**

3.0 DEVELOPMENT PROPOSALS

3.1 Nature of the development

3.1.1 This planning application is for the construction of 198no. residential dwellings on undeveloped land located to the east of Chipping Lane in Longridge (outlined in red within **Figure 2**). The proposals will be complete with access via the approved Phase 1 scheme, footpaths, car parking, external works lighting, landscaping, boundary walls/fencing, external services and drainage as shown on the illustrative masterplan in **Figure 2** (full layout in **Appendix G**).

Figure 2: Illustrative Masterplan (2021)

3.1.2 The total site area covers 10.66ha and is considered to be 100% permeable at present. Due to the nature of the proposals, the proposed residential development area is smaller than the total site and covers 6.24ha. The development area excludes areas which are proposed to remain undeveloped, used for recreation and allocated for the new school. The post-development impermeable areas of the site will increase due to the nature of the development, to approximately 2.81ha which is 45% of the proposed development area.

3.1.3 There are Ordinary Watercourses present on and adjacent to the site which have been considered within the proposals. In accordance with Lancashire County Council (LLFA) there is a requirement to maintain easements from existing Ordinary Watercourses. LCC typically require an 8m easement to be maintained from the Top of Bank of the watercourses into the development area. The easement should provide clear and unimpeded access for future maintenance. This includes no fencing, walls or buildings should be present within the designated easement. Ordinary Watercourses are required to remain open channel where possible however, culverting of the watercourse for crossing purposes is typically accepted by LCC. Culverting of the watercourse for vehicle crossing as with Phase 1 is allowed providing the culverting is kept to a minimum and follows LCC design requirements. Early discussion with LCC is advised to get approval of any culvert proposals.

3.1.4 In review of Untied Utilities (UU) sewer records, a foul water pumping station has been identified onsite adjacent to the southern boundary, this pumping station has been accounted for within the planning proposals. A public foul water sewer (375mm.dia) associated with the pumping station has also been identified onsite adjacent to the southern boundary. In addition, there is also a public surface water sewer (375mm.dia) which presently crosses the development site from the southern boundary towards Phase 1.

3.1.5 National and local policy identifies that Sustainable Drainage Systems (SuDS) should be incorporated into new development where at all feasible. As shown on the proposed planning layout there is scope to incorporate some SuDS features such as a pond/basin within the proposed open space/amenity areas. There is also a blue/green corridor shown on the planning layout to border the Ordinary Watercourse crossing the site. Detailed design will however be required to confirm the specific types, subject to ground investigations and detailed levels review.

4.0 SOURCES OF FLOOD RISK

4.1 Fluvial Flood Risk

4.1.1 Information relating to flood risk at the site has been obtained from the Environment Agency and from the Gov.uk website. The Flood Map for Planning shows that the site is wholly located within Flood Zone 1 as seen in **Figure 3**, the site is also identified to be at 'very low' risk of fluvial flooding based on the long-term fluvial flood risk mapping (refer to mapping in **Appendix B**).

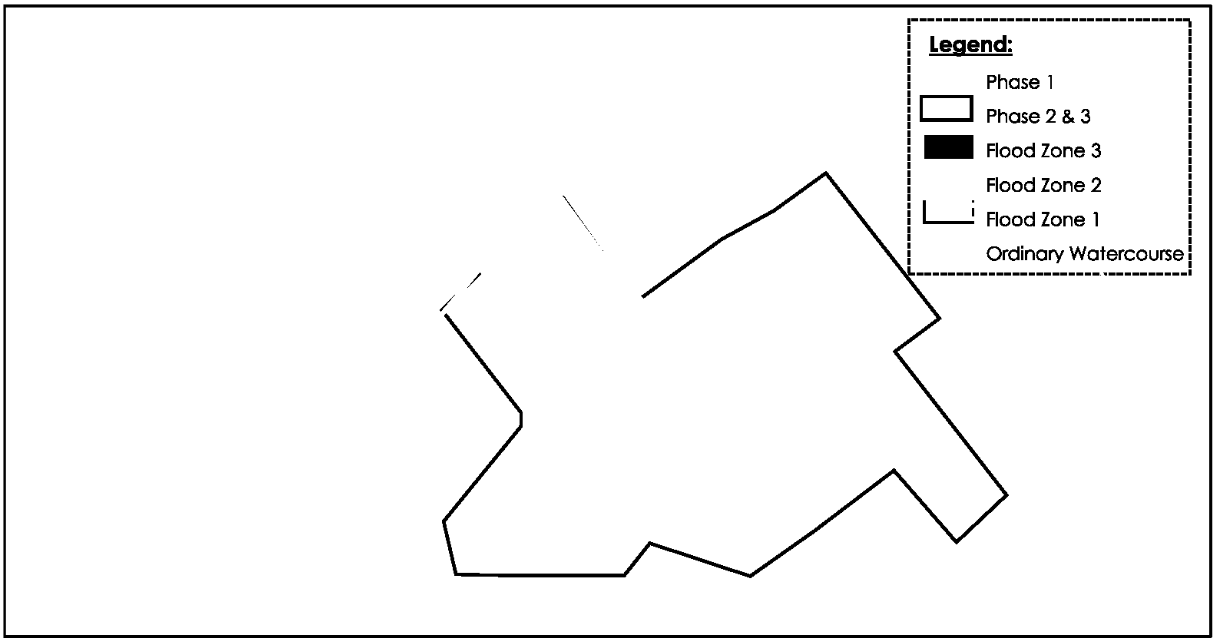


Figure 3: Fluvial/Tidal Flood Zone Map for Planning Extract (GOV.UK 2021)

4.1.2 There is an existing Ordinary Watercourse crossing the development site, which flows north until the watercourse outfalls into Higgin Brook approximately 1km to the north. Higgin Brook flows north and eventually outfalls into the River Loud (Main River) located approximately 1.2km north of site. Due to the distance of site to the nearest Main River, the risk associated is 'very low'.

4.1.3 In terms of the Ordinary Watercourse, consultations with the EA, RVBC and LCC also did not identify any historic flooding at the site and review of the topographic survey suggests that the existing site levels are 800mm above the bed levels of the Ordinary Watercourses crossing the site. Due to the nature and scale of the existing Ordinary Watercourse, the flood risk associated is considered to be 'very low'.

4.1.4 The LLFA (LCC) will require a maintenance easement to be maintained from the existing Ordinary Watercourse for future maintenance. The LCC typically require an 8m easement to be maintained from the Top of Bank of Ordinary Watercourses into the development area. The easement should provide clear and unimpeded access for future maintenance including no fencing, walls or buildings. Ordinary Watercourses are also required to remain open channel where possible. Culverting of the watercourse for crossing purposes however, is typically accepted by LCC as with Phase 1 of development, providing the culverting is kept to a minimum and follows LCC design requirements. Early discussion with LCC is advised to get approval of any culvert proposals.

4.1.5 As part of the Phase 1 application, hydraulic modelling of the Ordinary Watercourse crossing the site was undertaken to determine the potential flow risks associated with the proposed part culverting the Ordinary Watercourse for crossing. The section below draws on outcomes of the modelling exercise to further evidence the risk to the proposals from the Ordinary Watercourse is low.

Hydraulic Assessment

4.1.6 For full details of the Ordinary Watercourse model build and parameters, refer to the full separate Hydraulic Assessment (HA) Report which has been included in **Appendix H**). This section of the Flood Risk Assessment will summarise the key findings of the separate report. The HA used The Flood Estimation Handbook (FEH) to obtain the catchment descriptors for Higgin Brook upstream of a point north of the development site. Three smaller sub-catchments (Sub A, Sub B and Sub C) upstream of the 600mm culvert located adjacent to Chipping Lane to the north of the site were identified using LiDAR data (see Hydraulic Assessment in **Appendix H** for full methodology).

4.1.7 The Revitalised Flood Hydrograph (ReFH) method was then applied for each sub-catchment based on catchment descriptors. The full hydrographs for all sub-catchments in all return periods are shown in **Appendix H**. The HA considered the following events:

- 1 in 5 year (20% AEP)
- 1 in 30 year (3.3% AEP)
- 1 in 100 year (1% AEP)
- 1 in 100 year (1% AEP) plus Climate Change (CC)

4.1.8 The results of the simulations have been presented in the form of longitudinal profile and cross sections (including peak water levels) included in **Appendix H**. The results show that water levels remain in bank for most of the Ordinary Watercourse reach in all Annual Exceedance Probabilities in the existing scenarios. In the proposed scenario a 600mm diameter pipe, approximately 26m long, was inserted upstream to simulate a proposed culvert crossing. Comparison of the existing and post development levels in the 1% AEP plus climate change event shows that peak levels remain largely unchanged, although with some small increases in places. These increases are relatively small and do not increase flood risk to the proposed development or neighbouring areas.

4.1.9 Sensitivity analysis was carried out on the model parameters and showed that water levels were not particularly sensitive to changes in channel roughness, therefore the impact of the proposed development on flood depths in vicinity of the site and the wider floodplain are low and within modelling tolerances. Overall, when the outcomes of the proposed scenario of the previously completed FRA are considered, the risk of the proposed development as part of Phase 2 & 3 is minimal.

Safe Access and Egress

4.1.10 The access road to site was previously approved as part of the Phase 1 application (Ref: 3/2014/0764). This is shown on the EA's Flood Zone Map for Planning, to also be located within Flood Zone 1. Safe access and egress will therefore be maintained via Chipping Lane (through Phase 1).

4.2 Tidal Flood Risk

4.2.1 The coastline is located approximately 30km west of the proposed site and the Ribble Estuary is located approximately 20km west of site. Due to the distance from the coast, the associated flood risk from these sources is considered to be 'very low'. This is supported by the EA's Fluvial/Tidal Flood Zone Map for Planning as the site is shown to be located within Flood Zone 1.

4.3 Flood Risk Vulnerability Classification and Flood Zone Compatibility

4.3.1 The proposals are solely 'residential' in nature and as such is classified as 'More Vulnerable' in Table 2: Flood Risk Vulnerability Classification within the PPG. Table 3: Flood Risk Vulnerability and Flood Zone 'Compatibility' within the PPG confirms that this type of land use is appropriate for Flood Zone 1, providing there is no increase in flood risk elsewhere due to the proposals.

4.4 Surface Water Flood Risk

4.4.1 Surface water flooding occurs when rainwater is unable to drain away through the normal drainage systems or soak into the ground but lies on or flows over the ground instead. The risk associated with surface water run-off is indicated by the long-term flood mapping (extract shown in **Figure 4**).

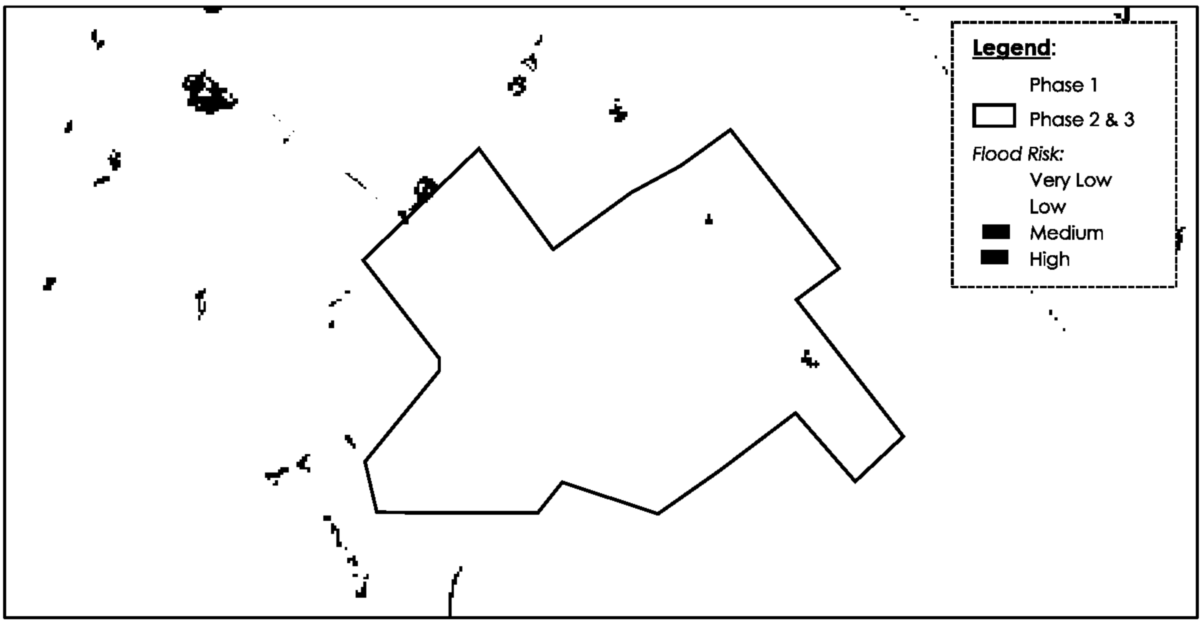


Figure 4: Surface Water Flood Map Extract (GOV.UK, 2021)

4.4.2 As indicated in **Figure 4**, the site is predominantly at 'very low' to 'low' risk from flooding associated with surface water. There are however some existing areas of 'medium' to 'high' risk shown onsite. A review of the existing topography shows that these higher flood risk areas are closely associated with the natural low-lying drainage ditches or existing water bodies including the Ordinary Watercourse and existing pond features onsite. These low-lying areas would be susceptible to ponding in the extreme rainfall events as the surrounding ground levels are elevated in comparison (refer to **Appendix F** for topographic survey).

4.4.3 The flood risk to the proposals from surface water will be inherently reduced, post-development through the design and implementation of a sustainable surface water drainage regime onsite. Interception methods may be beneficial along any boundary where run-off can enter site or cause risk to others. For any residual risks it is advised that (following any re-grade of the site) FFL are raised above the external levels to provide overland flood routes for excess surface water run-off; this will help protect properties from excess surface water run-off.

Pluvial (Overland run-off) Flood Risk

4.4.4 Intense rainfall that is unable to soak into the ground or enter drainage systems can run-off land and result in flooding. Local topography and the land use can have a strong influence on the direction and depth of flow. The topography of the surrounding undeveloped areas means there is little potential for overland flows to impact on the site, as levels generally fall towards the existing watercourses.

4.4.5 The volume and rate of overland flow from land can be exacerbated, if development increases the percentage of impermeable area. Any overland flows generated by the development must be carefully controlled; safe avenues directing overland flow away from adjacent development is advised.

Sewer Flood Risk

4.4.6 In urban areas, rainwater is frequently drained into surface water sewers or sewers containing both surface and waste water known as 'combined sewers'. Foul water flooding often occurs in areas prone to overland flow and can result when the sewer is overwhelmed by heavy rainfall and will continue until the water drains away.

4.4.7 United Utilities (UU) records identify there to be a foul water pumping station onsite adjacent to the southern boundary (see sewer records in **Appendix C**). This pumping station has been accounted for within the planning proposals and a public foul water sewer (375mm.dia) associated with the pumping station has also been identified onsite adjacent to the southern boundary. In addition, there is also a public surface water sewer (375mm.dia) which presently crosses the development site from the southern boundary towards Phase 1. Consultation with UU, identified no recorded historical sewer flooding issues on or near to the proposed development site (see **Appendix C** for correspondence).

4.5 Groundwater Flood Risk

4.5.1 High groundwater levels are usually the key source of groundwater flooding, which occurs when excess water emerges at the grounds surface (or within manmade underground structures such as basements). Groundwater flooding is often more insistent than surface water flooding and would typically last for weeks/months rather than days meaning the result to property is often more severe.

4.5.2 In general terms groundwater flooding can occur from three main sources:

- If groundwater levels are naturally close to the surface, then this can present a flood risk during times of intense rainfall. No groundwater flood risk has been identified during consultation with the various interested parties.
- Seepage and percolation occur where embankments above ground level hold water. In these cases, water travels through the embankment material and emerges on the opposite side of the embankment. At present there are no reported problems with groundwater flooding.
- Groundwater recovery/rebound occurs where the water table has been artificially depressed by abstraction. When the abstraction stops the water table makes a recovery to its original level. There is the potential for groundwater flooding in low lying areas where groundwater levels have been depressed below their pre-pumping conditions, where these were at or close to ground level. As with the seepage scenario the likelihood of flooding from this source is low.

4.5.3 The mapping data for groundwater shows that the site is underlain by a Secondary A Bedrock Aquifer with Secondary 'Undifferentiated' Superficial Deposits (**Appendix B**). The site has been identified to be in a Low Groundwater Vulnerability Area to a Minor Aquifer.

4.5.4 No historical groundwater flooding of the site has been identified during consultation with the various interested parties. Irrespective, it is advised that external levels fall away from the property (where feasible) to minimise the flood risk from a variety of sources. By keeping the finished floor levels elevated relative to the externals, this should help create an overland flow route.

4.6 Artificial Sources of Flood Risk

4.6.1 National policy states that an FRA should consider the potential risks from a variety of other flood sources including artificial sources (such as risks from reservoirs and canals).

Reservoirs

4.6.2 The EA recognises reservoirs as bodies of water over 25,000cu.m, the site is not considered to be influenced by any flooding associated with a breach or failure in the neighbouring reservoirs.

4.6.3 There are a number of small bodies of water (less than 25,000cu.m) located to the north of the development site and are understood to aid in the natural drainage of the surrounding area. The risk they pose to site is considered to be 'low' due to the natural topography and the scale/nature of these small drainage features.

Canals

4.6.4 The nearest identified canal systems to the proposed development site is the Lancaster Canal located approximately 1km to the west of site. Due to the proximity and the local topography, the associated flood risk is considered to be 'low'.

4.6.5 Irrespective, it is advised that external levels fall away from the property (where feasible) to minimise the flood risk from a variety of sources. By keeping the Finished Floor Levels elevated relative to the externals, this should help create an overland flood flow route in the event of a breach or any other source of flooding that could lead to overland flow.

4.7 Historical and Anecdotal Flooding Information

4.7.1 An internet-based search for flooding did not identify any historical flooding directly to the site however, the internet-based search did identify surface water flooding issues to the neighbouring Longridge area during extreme storm events. Furthermore, review of the Lancashire County Council's and Ribble Valley Borough Council's Preliminary Flood Risk Assessment and Strategic Flood Risk Assessment, did not highlight any historic flooding pertinent to this FRA.

4.7.2 Consultation with various interested parties including the EA also failed to highlight any historical flooding on the site. No historical sewer flooding issues onsite were highlighted by UU or within the wider area (correspondence in **Appendix B** and **C** respectively).

4.8 Flood Risk Mitigation Measures & Residual Risks

4.8.1 The site is located within Flood Zone 1 and considered to be at little risk of fluvial/tidal flooding. To observe a conservative approach however, mitigation measures have been proposed below to safeguard the development with regards to other potential residual sources of flood risk and to consider the uncertainties of climate change in accordance with the NPPF and PPG.

Mitigation Measures

4.8.2 For 'more vulnerable' development located within Flood Zone 1, it is typical to set the Finished Floor Levels (FFL) of residential dwellings to a minimum of 150mm above the existing ground levels. By ensuring the FFLs are raised sufficiently above the external levels (following any re-grade) should mitigate any risk of flooding from a variety of sources, including groundwater and surface water run-off risks at the proposed development.

4.8.3 Any overland flows generated by the development must be carefully controlled. Safe avenues directing overland flow way from any existing and proposed buildings are advised. Some areas of the site are shown to be at higher risk from surface water, these areas correspond with the existing drainage ditches and pond features. It would be recommended that the existing drainage features be retained where practical and/or mimicked within the development to make allowance for natural conveyance through the proposals.

4.8.4 In accordance with LCC there is a requirement to maintain an easement from the existing Ordinary Watercourse for future maintenance. The LCC typically require an 8m easement to be maintained from the Top of Bank of Ordinary Watercourses into the development area. The easement should provide clear and unimpeded access for future maintenance including no fencing, walls or buildings. Ordinary Watercourses are also required to remain open channel where possible. Culverting of the watercourse for crossing purposes however, is typically accepted by LCC as occurred on Phase 1 of development, providing the culverting is kept to a minimum and follows LCC design requirements. Early discussion with LCC is advised to get approval of any culvert proposals.

4.8.5 To minimise the flood risk to the neighbouring properties it is recommended that the surface water run-off generated by the proposals be managed effectively with the peak rates of run-off being restricted to the equivalent of the pre-development situation (with betterment). The proposed onsite surface water drainage system will need to be sized to contain the 1 in 30yr return period event below ground with exceedance from storm events up to and including the 1 in 100yr return period storm event with a 40% allowance for climate change being contained onsite.

4.8.6 As with any drainage system blockages within either the foul or surface water system have the potential to cause flooding or disruption. It is important that should any drainage systems not be offered for adoption to either the Water Company or the Local Authority then an appropriate maintenance regime should be scheduled with a suitably qualified management company for these private drainage systems.

Residual Risks

4.8.7 If an extreme rainfall event exceeds the design criteria for the drainage system it is likely that there will be some overland flows that are unable to enter the system, it is important that these potential overland flows are catered for within the development site if the capacity of the drainage system is exceeded.

5.0 SURFACE WATER MANAGEMENT

5.1 Pre-Development Surface Water Run-off

5.1.1 Phase 2 & 3 of the development covers 10.66ha. The proposed development area (excluding areas onsite such as the POS areas and the area allocated for a new school) and will cover 6.24ha based on the proposed planning proposals. At present the development area is 100% permeable and is understood to drain naturally to the onsite Ordinary Watercourse, which ultimately outfalls into Higgin Brook located to the north of the site.

5.1.2 The peak rates and volumes of run-off generated by Phase 2 & 3's development area has been calculated for the peak events shown in **Table 1** (full details **Appendix J**). The surface water run-off rates have been calculated using the FEH Statistical Method.

Site Area	Run-Off Rates				Run-Off Volumes	
	1 In 1 Year	1 In 30 Year	1 In 100 Year	QBar	1 In 1 Year	1 In 100 Year
6.236ha	73.8l/s	144.3l/s	176.5l/s	84.9l/s	710.7cu.m	2178.7cu.m

Table 1: Pre-Development Surface Water Run-Off Rates (Betts Hydro, 2021)

5.2 Post Development Surface Water Run-Off

5.2.1 At present the indicative proposals show the development area to cover 6.24ha of the wider site. Based on the planning layout we have estimated that the post-development impermeable areas will increase to approximately 45% of the development area. The unrestricted post-development run-off rates have been detailed in **Table 2**.

Site Area	Run-Off Rates		
	1 In 1 Yr	1 In 30 Yr	1 In 100 Yr +CC
2.806ha	150.2l/s	291.3l/s	488.5l/s

Table 2: Post-Development Un-Restricted Run-Off Rates (Betts Hydro, 2021)

5.2.2 In accordance with national and local planning policies it is necessary to restrict surface water run-off rates where at all practical to mimic a pre-development greenfield situation. The proposals will therefore be to discharge surface water run-off from site mimicking the pre-development greenfield situation (**Table 1**). Further details of proposed drainage strategy can be found in Section 5.6.

5.3 Sustainable Drainage Systems (SuDS)

5.3.1 Sustainable Drainage Systems (SuDS) can address the four key sustainability objectives including: water quantity, water quality, amenity and biodiversity. Peak surface water discharge rates to watercourses and sewers should be appropriately managed and where possible reduced. Preference should always be given to SuDS over the traditional methods of buried sewers wherever possible and practical.

5.3.2 It would be beneficial to implement wider green space/Public Open Space area(s) in one or more locations within site, where SuDS features could be implemented. Multiple benefits to using SuDS include the improvement of bio-diversity, aesthetics, ecology and water quality. Opportunities should also be taken to provide soft landscaping where at all possible on site to assist in minimising surface water run-off.

5.3.3 Given the indicative layout, there may be the opportunity to incorporate SuDS methods such as swales and ponds (**Figure 5**) within the non-developed areas, to provide a degree of treatment before flows are carried offsite. It would also be recommended that permeable paving and bio-filtration be considered in non-adopted areas where at all feasible; to assist locally with surface water management (subject to optimum ground conditions). If infiltration is not feasible then a connection into the main drainage systems would be needed.

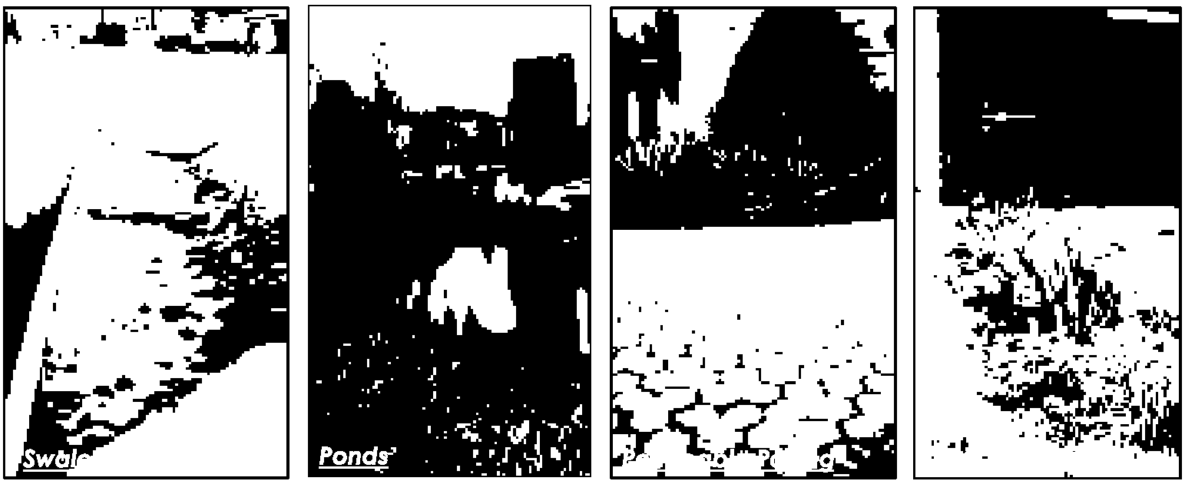


Figure 5: SuDS Photographs (SusDrain, 2012)

5.3.4 Promoting SuDS to deal with surface water at the source, will limit the required attenuation and in turn reduce the volume of surface water in the nearby watercourse and sewer infrastructure. There may be the potential to utilise SuDS features for conveyance/attenuation of surface water flows within the proposed drainage strategy, opposed to the traditional below ground storage methods. Detailed design should confirm whether this site would be suitable for incorporation of SuDS following more detailed analysis of levels, ground conditions and attenuation requirements.

5.4 Methods of Surface Water Management

5.4.1 At present the development area for Phase 2 & 3 covers 6.24ha and the proposed impermeable area is assumed to increase from 0% to 45%. There are three methods that have been reviewed for the management and discharge of surface water. These may be applied individually or collectively to form a complete strategy and should be applied in the order of priority listed below:

- Discharge via infiltration
- Discharge to watercourse
- Discharge to public sewerage system

5.5 Discharge via Infiltration

5.5.1 Any impermeable areas that can drain to soakaway or an alternative method of infiltration would significantly improve the sustainability of any surface water systems.

5.5.2 The Cranfield Soil and AgriFood Institute (CSAI), Soilscapes viewer identifies the soils to be slowly permeable, seasonally wet, slightly acid but base-rich loamy and clayey. The British Geology Survey (BGS) mapping data indicates that the bedrock geology consists of a mixture of Bowland Shale Formation (Mudstone) and Pendleside Sandstone Member (Sandstone) and has superficial deposits associated with Till and Devensian.

5.5.3 Based on the ground conditions identified by the published online datasets, it can be considered that infiltration would not likely provide a viable drainage solution for the development site due to the impermeable strata. A ground investigation report (Ref: STN3505NM-G01) was also undertaken for Phase 1 and identified soakaways were not suitable to be used as a method for managing surface water run-off. Infiltration rates however, vary on a site by site basis and therefore it would be recommended further investigation in the form of Soakaway Testing to BRE365, takes place within Phase 2 & 3 areas upon planning approval, to confirm these areas are also not suitable for an infiltration-based solution.

5.6 Discharge to Watercourse

5.6.1 Assuming infiltration is not suitable for managing all the surface water run-off generated by the development, the next method in the drainage hierarchy is discharge surface water to a watercourse. As previously mentioned, most of the site naturally drains into the Ordinary Watercourse crossing the development site.

5.6.2 The surface water run-off generated by the development is therefore proposed to mimic the existing situation and discharge into the existing Ordinary Watercourse crossing the development site, as illustrated in the preliminary drainage proposals plan (**Figure 6**). This approach is similar to that proposed and agreed for the earlier Phase 1 and mimics the existing situation through the current mechanisms of run-off management.

5.6.3 Detailed design will need to be carried out to confirm whether a site wide gravity solution can be achieved. Although, the site naturally drains to the Ordinary Watercourse at present, when the development proposed levels are considered and formal connections made. It is likely that multiple surface water outfalls will be required to accommodate the layout proposals, the specifics will be confirmed during detailed design.

5.6.4 Consents will be required from LCC who are the LLFA and responsible in part for Ordinary Watercourses in terms of proposed works. Consent would be required for any new outfall structures on the Ordinary Watercourse, and any culverting (to accommodate crossings shown on the layout). Agreement would also be required for the proposed rates of discharge to the Ordinary Watercourse, to ensure no increase risk to others result from the site.

5.6.5 In accordance with the LCC, there is a requirement to maintain an easement from existing Ordinary Watercourses and Main Rivers. The EA and LCC both require an 8m easement to be maintained from the Top of Bank of the watercourse into the development area. The easement should provide clear and unimpeded access for future maintenance no fencing, walls or buildings should be present within the designated easement as shown within the proposed planning layout.

Figure 6: Preliminary Proposed Drainage Plan extract (Betts Hydro, 2021)

5.6.6 In accordance with the SuDS Manual (CIRIA 753) and the Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015) all sites should endeavour to achieve as close to pre-development greenfield rates as is viable. Based on the development area, the pre-development greenfield rate (QBar) is calculated to be 84.9l/s using the FEH Statistical Method (see summary in **Appendix J**). The proposals are therefore to restrict surface water run-off to mimic a pre-development greenfield situation. The overall rate of discharge would need to be proportioned between the number of outfalls where necessary. This will be confirmed during detailed design, when the drainage technical detailed are reviewed.

Impermeable Area (2.806ha)	**1 In 1 Year**	**1 In 30 Year**	**1 In 100 Year + 30% CC**
Restricted Run-Off Rate	84.9l/s	84.9l/s	84.9l/s
Estimated Stormwater Storage Volume	117cu.m-290cu.m	515cu.m-853cu.m	1113cu.m-1720cu.m

Table 4: Estimated Stormwater Storage Requirements (Betts Hydro, 2021)

5.6.7 It would be beneficial to implement SuDS features where at all feasible, subject to ground investigation and a detailed levels review. If designed appropriately the SuDS features such as a pond/basin could potentially aid in the attenuation requirements for the proposals (if located appropriately) and provide added benefits in terms of water quality improvements. Detailed design will be required to confirm whether SuDS can be incorporated, at present indicative proposals allow for the inclusion of SuDS, including a pond/basin at multiple outfall points proposed.

5.7 Discharge to Public Sewer Network

5.7.1 UU sewer records identify there to be a public surface water sewer (375mm.dia) which presently crosses the development site from the southern boundary towards Phase 1. Should infiltration not be feasible then the surface water flows generated are proposed to discharge to the existing Ordinary Watercourse crossing the site and not the existing sewer network.

5.8 Climate Change

5.8.1 There are indications that the climate in the UK is changing significantly and it is widely believed that the nature of climate change will vary greatly by region. Current expert opinion indicates the likelihood that future climate change would produce more frequent short duration and high intensity rainfall events with the addition of more frequent periods of long duration rainfall. It is believed that the impact of climate change means there is likely to be a long-term increase in the average sea levels, with an expectation that sea levels will rise gradually. An increase in flood water levels means that future flooding events will occur more frequently and will have a greater impact.

5.8.2 In light of the future uncertainties Climate Change should be accounted for within the design of all new developments. The recently published Environment Agency document '*Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities*' supersedes Defra's policy statement on Flood Risk and Coastal Erosion Risk Management (2009) and should be used for future proposals. Climate change factors have been considered and any increase in the level of flood risk (to the site) from climate change is likely to be related to the increase in rainfall intensity and duration and its impact upon the surface water drainage system.

5.8.3 The site is subject to an existing outline approval (Ref: 3/2014/0764) and the design of Phases 2 & 3 of this development will conform to the criteria already agreed and embedded in the approved planning documentation. The Climate Change factor that has been considered for an increase in rainfall intensity is 30%

6.0 FOUL WATER MANAGEMENT

6.1 Due to the existing land-use onsite, no existing foul water connections to the public sewer network are present. Review of the UU sewer records identifies a foul water pumping station onsite adjacent to the southern boundary. This pumping station has been accounted for within the planning proposals and a public foul water sewer (375mm.dia) associated with the pumping station has been identified onsite adjacent to the southern boundary (see sewer records in **Appendix C**).

6.2 Phase 1 has a separate approved drainage management strategy (REF: HYD068_CHIPPING.LANE_FRA&DMS) was detailed in the approved supporting FRA&DMS, which shows foul from this portion of development will outfall into the foul water system located within Inglewhite Road to the south-east of Phase 1 (**Appendix C**).

6.3 Based on the proposals for the construction of up to 198no. residential units for Phase 2 & 3, the approximate peak foul water flows generated by the development are 9.2l/s. This is based on 4000 litres per dwelling per 24 hours; the guidance contained within Sewers for Adoption (SfA).

6.4 The proposals are therefore to connect flows from Phase 2 & 3 to the foul water pumping station within Phase 1 which ultimately connects into the public sewer network within Inglewhite Road. The pumping station within Phase 1 has been designed to also accommodate flows from Phase 2 & 3 however, formal consent is still required from UU approving this connection, discussion with UU shown in **Appendix C**.

6.5 A pre-development enquiry was sent to UU in 2018, and an agreement in principle was confirmed allowing foul water to discharge at an unrestricted rate into the 300mm dia. public foul water sewer within Inglewhite Road. It is understood that this response has now expired and therefore a new pre-development enquiry has been sent to UU; however, a response is currently outstanding.

6.6 Detailed design will confirm the full technical details based on the engineering constraints. Consent from UU will be required for works to the public sewer infrastructure. It is recommended that early discussion is undertaken to confirm acceptance of the strategy and identify any additional considerations such as preferred point of connection and capacity constraints. Initial discussion has been carried out to get an agreement in principle at this time.

7.0 SUMMARY AND CONCLUSIONS

7.1 This Flood Risk Assessment and Drainage Management Strategy was commissioned by Barratt Homes referred to hereafter as 'the client'. This report has been prepared to support a full planning application for the construction of a residential development on land to the east of Chipping Lane in Longridge. Phase 1 has planning approval (Ref: 3/2014/0764) and is supported by a separate, approved Flood Risk Assessment and Drainage Management Strategy (HYD068_CHIPPING.LANE_FRA&DMS). This assessment therefore focuses on the residential development proposed as part of Phase 2 & 3 only. Phase 2 & 3 collectively cover 10.66ha, although the proposed development area covers a smaller portion at 6.24ha.

Flood Risk

7.2 The site is located wholly within Flood Zone 1 based on the Environment Agency Flood Map for Planning. The proposals are for a residential-led development, which is considered 'More Vulnerable' in Table 2: Flood Risk Vulnerability Classification within Planning Practice Guidance. This 'More Vulnerable' development is confirmed to be appropriate within Flood Zone 1, providing there is no increase in flood risk elsewhere due to the proposals.

7.3 Consultations with the Environment Agency, Ribble Valley Borough Council, Lancashire County Council and United Utilities have been undertaken and did not identify any historical incidents of flooding to the site or within the neighbouring areas. This assessment has considered all sources of flood risk, this includes the existing Ordinary Watercourse crossing the site which is understood to outfall into Higgin Brook 1km north of the site. As part of Phase 1, hydraulic modelling of the Ordinary Watercourse was undertaken to determine the potential flow risks associated with the proposed culverting the Ordinary Watercourse for vehicular crossing as part of Phase 1. The outcomes of the modelling exercise evidenced the risk to the proposals from the existing Ordinary Watercourse is low. The full Hydraulic Assessment has been appended to this assessment for full details. To summarise the proposed Phase 2 & 3 development area will, following the implementation of mitigation measures remain flood free in all key storm events, including the 1 in 100-year (1% AEP) plus Climate Change event without having any impact on the neighbouring land/properties.

7.4 The site is at 'very low' to 'low' flood risk from the reviewed sources of flooding. The primary source of flood risk is considered to be from surface water where the risk varies across the site from 'very low' to 'high' within the natural low-lying areas of site. The risks post-development from surface water will be effectively managed through implementation of the mitigation measures proposed within this assessment, including appropriate ground levels design and inclusion of a suitable surface water management infrastructure. To minimise flood risk from surface water it would also be recommended that natural drainage routes through the site be maintained within the proposals, including the existing Ordinary Watercourse, crossing the site from the southern boundary to the north.

Drainage Strategy

7.5 To ensure surface water flood risk to others does not increase, it is important to ensure surface water run-off is appropriately managed in accordance with the sustainable drainage hierarchy. Three methods have therefore been reviewed for the appropriate management of surface water run-off. These have been applied in the order of priority being; discharge via infiltration, to a watercourse and finally to public sewerage system.

7.6 Based on the ground conditions identified by the published online datasets, infiltration is not considered to provide a viable drainage solution for the development due to the impermeable strata. A ground investigation report (Ref: STN3505NM-G01) was also undertaken for Phase 1 and identified soakaways were not suitable to be used as a method for managing surface water run-off. As infiltration rates can vary on a site by site basis, the Local Planning Authority may still require onsite Soakaway Testing to be undertaken to evidence this is true for Phase 2 & 3, prior to full commencement of works.

7.7 Assuming infiltration is not feasible, the next method in the drainage hierarchy should be discharge to a watercourse. Most of the site naturally drains to the Ordinary Watercourse crossing the site at present and the proposals are therefore to mimic the existing situation, discharging surface water run-off from the site to the watercourse using the existing onsite features where practical. Detailed design will need to confirm feasibility of a site wide gravity solution, although this is anticipated as most of the site naturally drains in this manner at present. It is assumed that multiple outfalls to the watercourse will be required given the scale of the development and formal consents will be required from Lancashire County Council for any works to the Ordinary Watercourse, including agreement of the proposed discharge rates and points of connection.

7.8 In accordance with the SuDS Manual and the Non-Statutory Technical Standards for Sustainable Drainage Systems, all sites should endeavour to achieve as close to pre-development greenfield rates as viable. The proposals are to therefore discharge to the watercourse crossing the site mimicking pre-development greenfield situation, QBar is calculated to be 84.9l/s and will need to be proportioned between the multiple proposed points of outfall. Restricting the rate of discharge will generate an onsite stormwater storage requirement which will be catered for on the site prior to discharge to the watercourse. It would be beneficial to implement SuDS features including permeable surfaces and bio-filtration where at all feasible (subject to ground investigation and contamination review). Given the scale of development it is proposed that pond/basin features be included onsite near to the proposed outfall location(s). If designed appropriately the SuDS features could potentially aid in the attenuation requirements for the proposals and provide added benefits in terms of water quality. Detailed design will be required to confirm whether SuDS can be incorporated.

7.9 This Flood Risk Assessment and Drainage Management Strategy has been prepared in consultation with the relevant interested parties and incorporates their comments where possible. The report is commensurate with the scale and nature of the development proposals and in summary, the development can be considered appropriate in accordance with the Planning Practice Guidance.

8.0 RECOMMENDATIONS

8.1 For 'more vulnerable' development located within Flood Zone 1, it is typical to set the Finished Floor Levels (FFL) of residential dwellings to a minimum of 150mm above the existing ground levels. By ensuring the FFLs are raised sufficiently above the external levels (following any re-grade) should mitigate any risk of flooding from a variety of sources, including groundwater and surface water run-off risks at the proposed development.

8.2 Any overland flows generated by the proposed development must be controlled, safe avenues directing overland flow away from any existing and proposed buildings are advised. As with any development it is also advised that external levels fall away from property to minimise the flood risk from a variety of sources.

8.3 In accordance with LCC there is a requirement to maintain an easement from the existing Ordinary Watercourse for future maintenance. The LCC typically require an 8m easement to be maintained from the Top of Bank of Ordinary Watercourses into the development area. The easement should provide clear and unimpeded access for future maintenance including no fencing, walls or buildings. Ordinary Watercourses are also required to remain open channel where possible. Culverting of the watercourse for crossing purposes however, is typically accepted by LCC as occurred on Phase 1 of development, providing the culverting is kept to a minimum and follows LCC design requirements. Early discussion with LCC is advised to get approval of any culvert proposals.

8.4 To minimise the flood risk to the neighbouring property and proposed dwellings it is proposed that the surface water run-off generated by the proposals be managed effectively with the peak rates of run-off being restricted to the equivalent of the pre-development situation

8.5 Detailed drainage design will be required to refine the drainage strategy following more in-depth levels and layout review. Early discussion with all relevant parties including the EA, LCC, RVBC and UU is advised for any proposed works. Consents will be required from LCC who are the LLFA and therefore in charge of the Ordinary Watercourses in terms of proposed works. Consent would be required for any new outfall structures on the Ordinary Watercourse, and any culverting (to accommodate crossings shown on the layout). Agreement would also be required to agree the proposed rates of discharge to the Ordinary Watercourse.

8.6 The proposed onsite surface water drainage system will need to be sized to contain the 30yr return period event wholly below ground with overland run-off from storm events up to and including the 1 in 100yr return period storm event with a 40% allowance for climate change being contained onsite.

8.7 It is important that should any drainage systems not be offered for adoption to either the United Utilities or Lancashire County Council then an appropriate maintenance regime should be scheduled with a suitably qualified management company for these private drainage systems.

BIBLIOGRAPHY & REFERENCES

Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities – Environment Agency/DEFRA 2016
CIRIA 522: Sustainable urban drainage systems – design manual for England and Wales (2000).
CIRIA 523: Sustainable urban drainage systems – best practice manual (2001).
CIRIA 609: Sustainable drainage systems. Hydraulic, structural and water quality advice (2004).
CIRIA 624: Development and flood risk – guidance for the construction industry (2004).
CIRIA 635: Designing for Exceedance in urban drainage: Good practice (2006).
CIRIA 644: Building Greener (2007).
CIRIA 753: The SUDS manual (2015).
Flood Risk to People – Phase 2 (FD2321/TR2), DEFRA and the Environment Agency (2006).
Flood estimation for small catchments: Institute of Hydrology Report No.124, NERC (1994).
Flood Estimation Handbook, Centre for Ecology and Hydrology (1999).
Planning Policy Statement 25: Development and Flood Risk (2006).
Sewers for Adoption 7th Edition, WRc (2012).
National Planning Policy Framework, Ministry of Housing, Communities and Local Government (2018).

Web-based References

Bingmaps – http://www.bing.com/Maps/
British Geological Survey – http://www.bgs.ac.uk/opengeoscience/home.html
Chronology of British Hydrological Events – www.dundee.ac.uk/
CIRIA – http://www.ciria.org/
Cranfield University – http://www.landis.org.uk/soilscapes/
Environment Agency – www.environment-agency.gov.uk/
FloodProBE – http://www.floodprobe.eu/
Flood Forum – http://www.floodforum.org.uk/
Flood London – http://www.floodlondon.com/
Google Maps – http://maps.google.co.uk/
Streetmap – http://www.streetmap.co.uk/
United Utilities - https://www.unitedutilities.com/

Appendix C
Hydraulic Assessment

CONSULTING ENGINEERS

LAND AT CHIPPING LANE, LONGRIDGE

HYDRAULIC ASSESSMENT

For
Barratt Homes Manchester
4 Brindley Road,
City Park,
Manchester,
M16 9HQ.

July 2016

**LAND AT CHIPPING LANE,
LONGRIDGE**

HYDRAULIC ASSESSMENT

Document Tracking Sheet

Document Reference: HYD068_CHIPPINGLANE_HYDRAULIC_ASSESSMENT
Revision: 1.0
Date of Issue: 8th July 2016
Report Status: FINAL

Prepared by: [redacted]
[redacted] BEng (Hons), MSc, PhD
Principal Hydraulic Analyst

Checked by: [redacted]
[redacted] BEng (Hons) MBA
Director

Authorised by: [redacted]
Director

Revision History:

Rev.:	**Date:**	**Status:**	**Prepared by:**	**Checked by:**	**Issued by:**
1.0	04/07/16	Final	DK	RN	DK

CONTENTS

Figures & Tables

Specialist Software

- Flood Estimation Handbook FEH CD-ROM (v.3.0) – Determination of Catchment Descriptors and depths of rainfall.

- ISIS (3.7) – 2013 - 1D Hydraulic Model

Abbreviations & Acronyms

AEP	Annual Exceedance Probability	mAOD	Metres Above Ordnance Datum
BGL	Below Ground Level	NGR	National Grid Reference
CC	Climate Change	NPPF	National Planning Policy Framework
EA	Environment Agency	OS	Ordnance Survey
FEH	Flood Estimation Handbook	PFRA	Preliminary Flood Risk Assessment
FRA	Flood Risk Assessment	PPS	Planning Policy Statement
FZ	Flood Zone	SFRA	Strategic Flood Risk Assessment
Ha	Hectare	LCC	Lancashire County Council
LLFA	Lead Local Flood Authority	TWL	Top Water Level
LPA	Local Planning Authority	UU	United Utilities

1.0 EXISTING SITE SITUATION

1.1 The proposed development site is located on land at Chipping Lane, Longridge and is directly accessed off Chipping Lane. The Ordnance Survey National Grid Reference (OS NGR) for the site is Eastings 360073, Northings 437980 and the nearest postcode is PR3 2NA.

1.2 The proposed development area is edged in red Figure 1 (below). A location plan is included Appendix A.

Figure 1: Aerial Photograph of site (proposed development area edged in red)

1.3 Two small watercourses enter the site from the south east and south west and flow in a north westerly direction, leaving the site via 600mm diameter culvert outfall by Chipping Lane north of the site.

1.4 The Environment Agency flood zone maps indicated that the site is entirely within Flood Zone 1, implying that the site is at low risk of fluvial flooding.

1.6 From a flood risk perspective it was considered prudent to undertake a hydraulic assessment of the watercourse to assess the peak water levels in the watercourse in both the existing and the post development scenarios.

2.0 DEVELOPMENT PROPOSALS

2.1 The initial proposals are a residential development within the red edge boundary indicated in Figure 2 and in Appendix B.

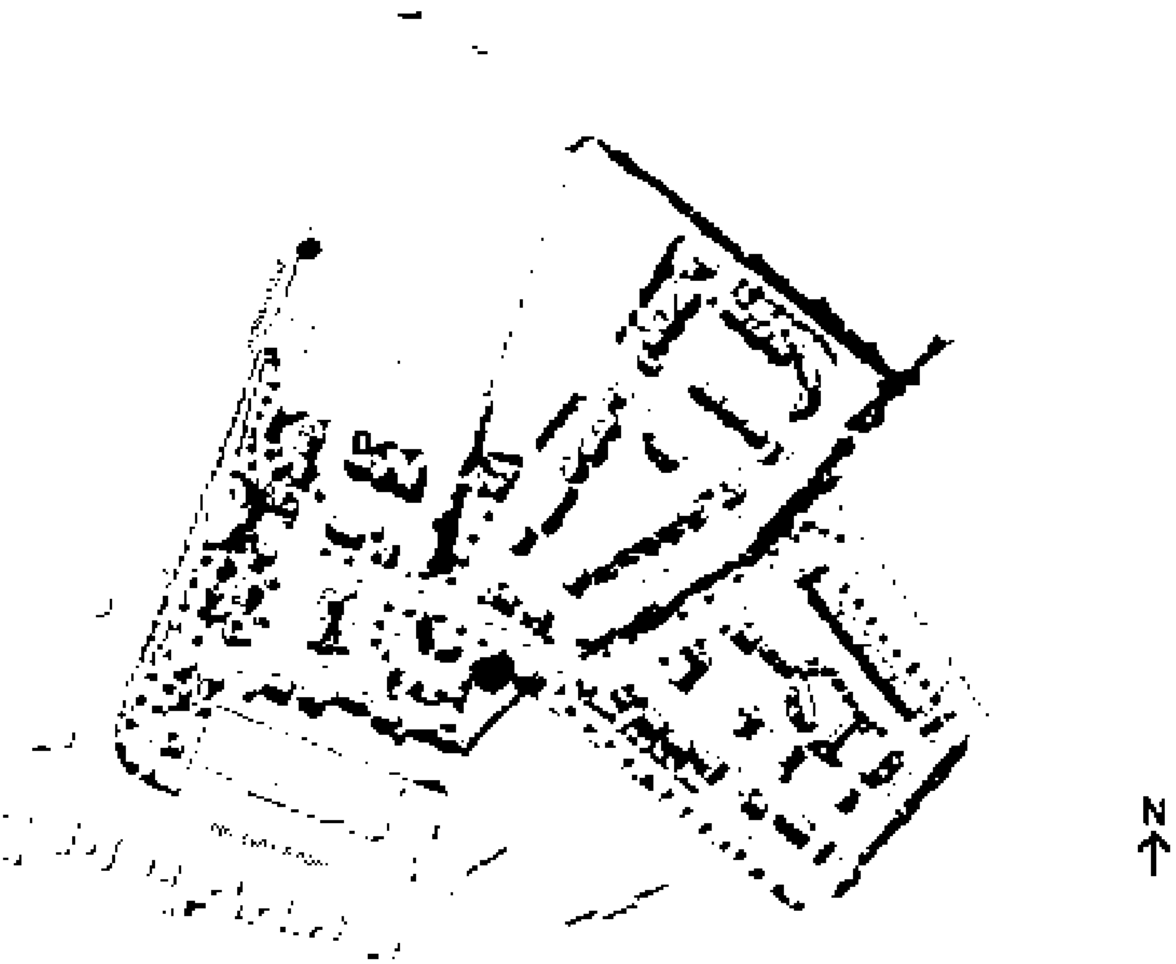


Figure 2: Indicative Planning Proposals

3.0 CATCHMENT DESCRIPTORS

3.1 The Flood Estimation Handbook (FEH) CD-ROM provided catchment descriptors for Higgin Brook upstream of a point north of the development site. Three smaller sub-catchments (Sub A, Sub B and Sub C) upstream of the 600mm culvert were identified using LiDAR data.

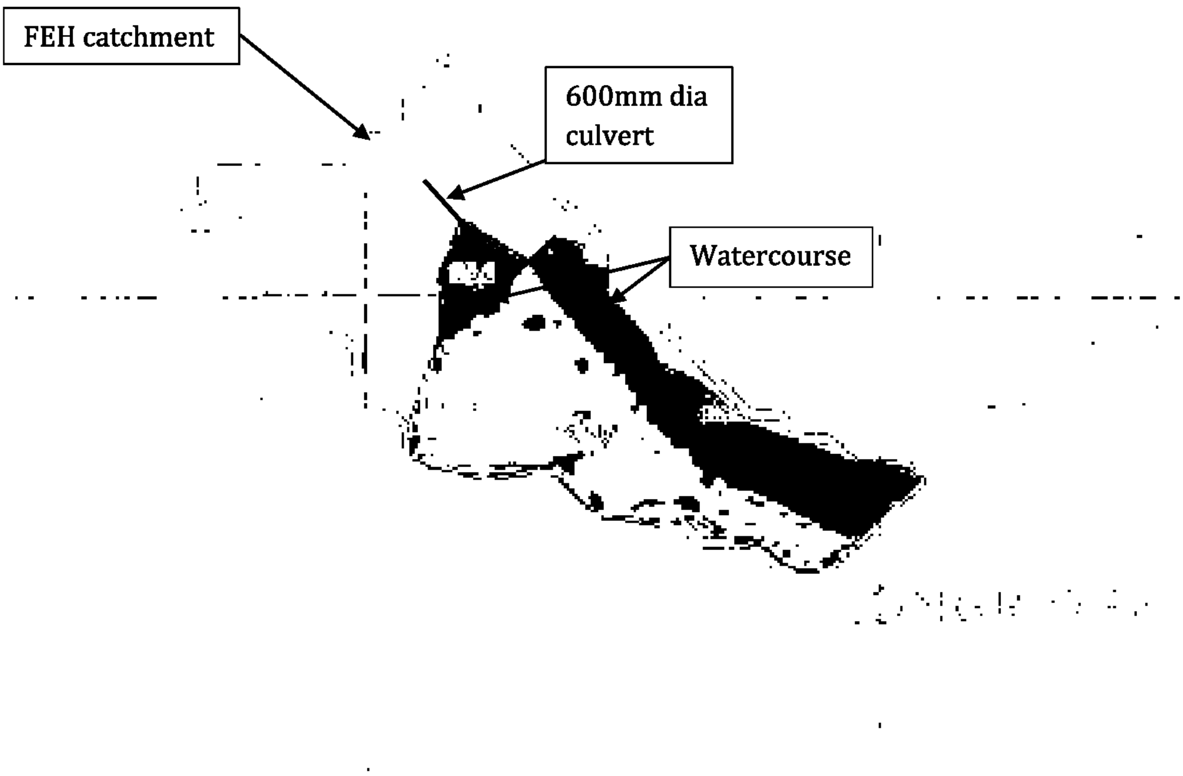


Figure 3: Upstream Sub-catchments

3.2 The FEH Catchment descriptors are summarised below and included in full in Appendix C.

Important Catchment Descriptors: All sub-catchments

DPSBAR (m/km)	22.3	Mean slope between nodes (m/km)
SAAR (mm)	1200	Standard annual average rainfall – 1961-1990
FARL	1.00	Flood attenuation due to reservoirs/lakes (no attenuation)
BFIHOST	0.417	Baseflow index from Hydrology of Soil Types
SPRHOST	35.03	Standard percentage runoff from soil types
PROPWET	0.51	Proportion of time catchment is wet
URBEXT1990	0.1643	Urban extent in 1990 (essentially rural)

3.3 The areas for the sub-catchments were calculated using GIS and mean drainage path length (DPLBAR) was calculated using formula 7.1 from the FEH Volume 5: Catchment Descriptors as follows: $DPLBAR = AREA^{0.548}$. The sub-catchment areas and DPLBAR values are shown in Table 1.

[redacted]		
[redacted]	0.093	0.272
[redacted]	0.200	0.414
[redacted]	0.022	0.123

Table 1: Sub-catchment specific characteristics

4.0 HYDROLOGY

4.1 The Revitalised Flood Hydrograph (ReFH) method was applied for each sub-catchment based on catchment descriptors. The $URBEXT_{1990}$ <0.5 and BFIHOST<0.65 for all sub-catchments, therefore the use of the ReFH method is appropriate.

4.2 This study has considered the 1 in 5 year (20% AEP), 1 in 30 year (3.3% AEP), 1 in 100 year (1% AEP) and the 1 in 100 year (1% AEP) plus climate change (CC) return period flows in the watercourses.

4.3 These are considered to represent conservative flow estimates (i.e. adopts the precautionary approach). The site is considered to be predominantly greenfield and the catchment characteristics from the FEH CD-ROM were utilised. The peak flow estimates are shown in Table 2 below. Full details are shown in Appendix D.

[redacted]				
[redacted]	0.11	0.18	0.24	0.29
[redacted]	0.20	0.32	0.45	0.54
[redacted]	0.03	0.06	0.08	0.10

Table 2: ReFH Peak Flow Estimates

4.4 The critical storm duration for the largest sub-catchment (Sub B) was 1.065 hours. It was assumed that the same storm would occur in all sub-catchments, as they are adjacent to one another.

4.5 The full hydrographs for all sub-catchments in all return periods are shown in Figures D.1 to D.10 in Appendix D.

5.0 HYDRAULIC MODELLING

Model Details

5.1 An unsteady state 1D model of the watercourse was developed using ISIS for the existing and the proposed development scenarios.

5.2 A topographical survey of the site and watercourse was undertaken and a 3D ground model was generated. Cross sections through the watercourse were generated from the ground model at locations shown in the model schematics shown in Figure 4. The cross sections (Figures E.1 to E.30) and watercourse profile (Figure E.15) are included in Appendix E.

5.3 The watercourse was modelled in the existing scenario for the 20%, 3.3%, 1% and 1% plus climate change AEP events.

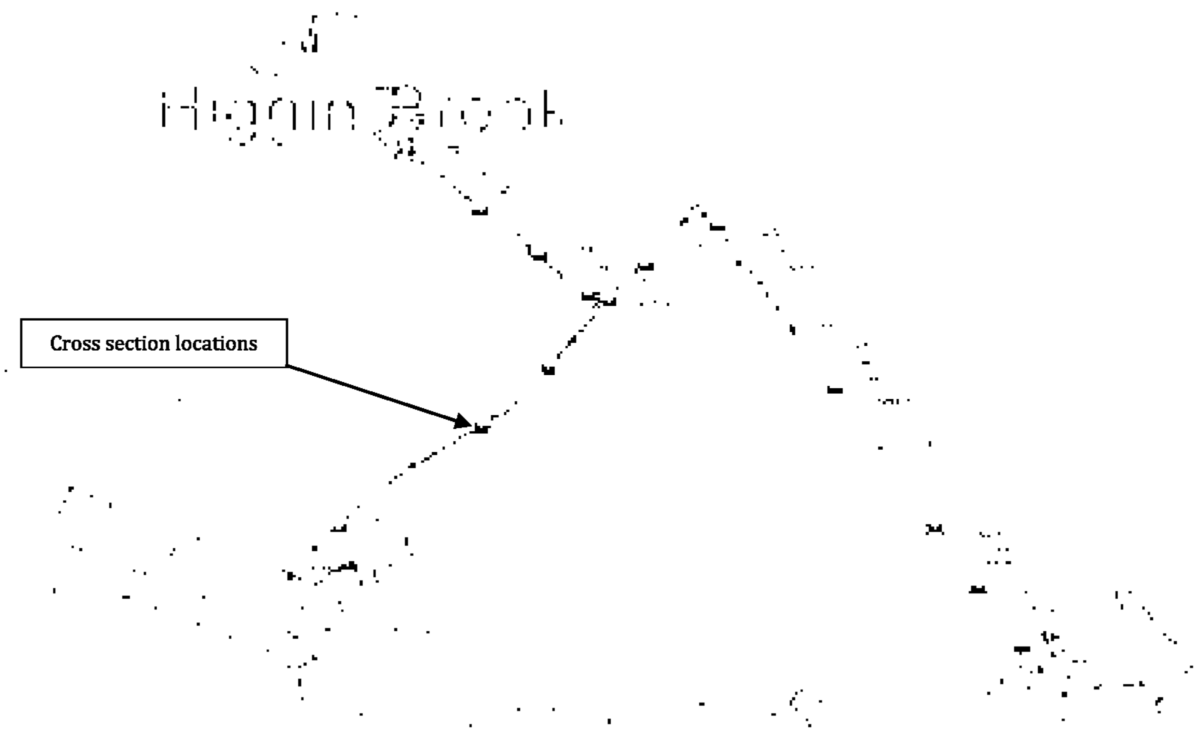


Figure 4: ISIS Model Schematic

5.4 Roughness coefficient allocation was based on aerial imagery. The watercourse channel is straight with some vegetation and as such the channel was assigned a roughness Manning's n value of 0.04 (refer to photographs in Appendix H).

5.5 There are seven structures within the modelled reach of the watercourse:

- 4 no. 300mm diameter pipes;
- 1 no. 525mm diameter pipe;
- 1 no. 575mm diameter pipe;

- 1 no. 600mm diameter pipe.

5.6 Overtopping of the bridges has been modelled in 1-D using a spill unit.

Model Assumptions

5.7 The cross sections were generated from a 3D ground model and so the profile of the channel may not be as true as if cross sections had been specifically surveyed. In some cases, the top water level on the date of the survey may have been used as the bed level. This approach is, however, conservative.

5.8 The diameters of pipes at cross sections 4, 9 and 15 have been assumed to be 300mm due to surveyed information not being available.

Model Results

Existing Scenario

5.7 The hydraulic modelling results including longitudinal profile and cross sections (including peak water levels) are included in Appendix E. Peak water levels for the 20%, 3.3%, 1% AEP and 1% AEP plus climate change events for the existing scenario are shown in Table 3.

5.8 The results show that water levels remain in bank for most of the reach in all AEPs. The peak water level is out of bank at the inlet to the 600mm diameter culvert.

Proposed Scenario

5.9 A 600mm diameter pipe, approximately 26m long, was inserted upstream of cross section number 26 to simulate a proposed crossing. The location of the new crossing is shown in Figure 5.

5.10 The hydraulic modelling results including longitudinal profiles and cross sections (including peak water levels) are included in Appendix F. Peak water levels for the 20%, 3.3%, 1% AEP and 1% AEP plus climate change events for the existing scenario are shown in Table 4.

5.11 Comparison of the existing and post development levels in the 1% AEP plus climate change event shows that peak levels remain largely unchanged, although with some small increases in places. The largest increase is of 27mm at cross section 26/26A, upstream of the proposed new culvert. There is also an increase of 25mm at cross section 25. These increases are relatively small and do not increase flood risk or the likelihood of surcharging of surface water outfalls.

Sensitivity Testing

5.12 Sensitivity testing was carried out on certain key model parameters to determine the effects on the simulated flows and water levels due to controlled changes in accordance with best practice.

5.15 The flow rate was increased by 20% and Manning's n values (channel roughness) were increased and decreased by 20%. These were all undertaken on the 1% AEP flow event (refer to Appendix G for the full sensitivity analysis results).

5.16 The increase in Manning's roughness coefficient, n, resulted in a mean increase in level of 0.022m and a maximum increase of 0.043m, occurring at cross section CS32 at the confluence of sub-catchments A and B. Reducing roughness coefficient by 20% had the effect of maximum decrease in water level of 0.057m. The mean effect was to reduce peak water levels by 0.021m.

5.17 Increasing flow by 20% resulted in a mean increase in peak water level of 0.073m and a maximum of 0.323m occurring at cross section CS07.

5.19 The sensitivity analysis has shown that water levels are not particularly sensitive to changes in channel roughness, with all mean and maximum changes within +/- 0.057m. When the 1% flow was increased by 20%, there were some isolated relatively large increases in water level, the maximum being 0.323m. The mean change was 0.073m and the change throughout most of the modelled reach was less than 0.100m.

5.20 The sensitivity due to these parameters should be taken into account when setting design levels.

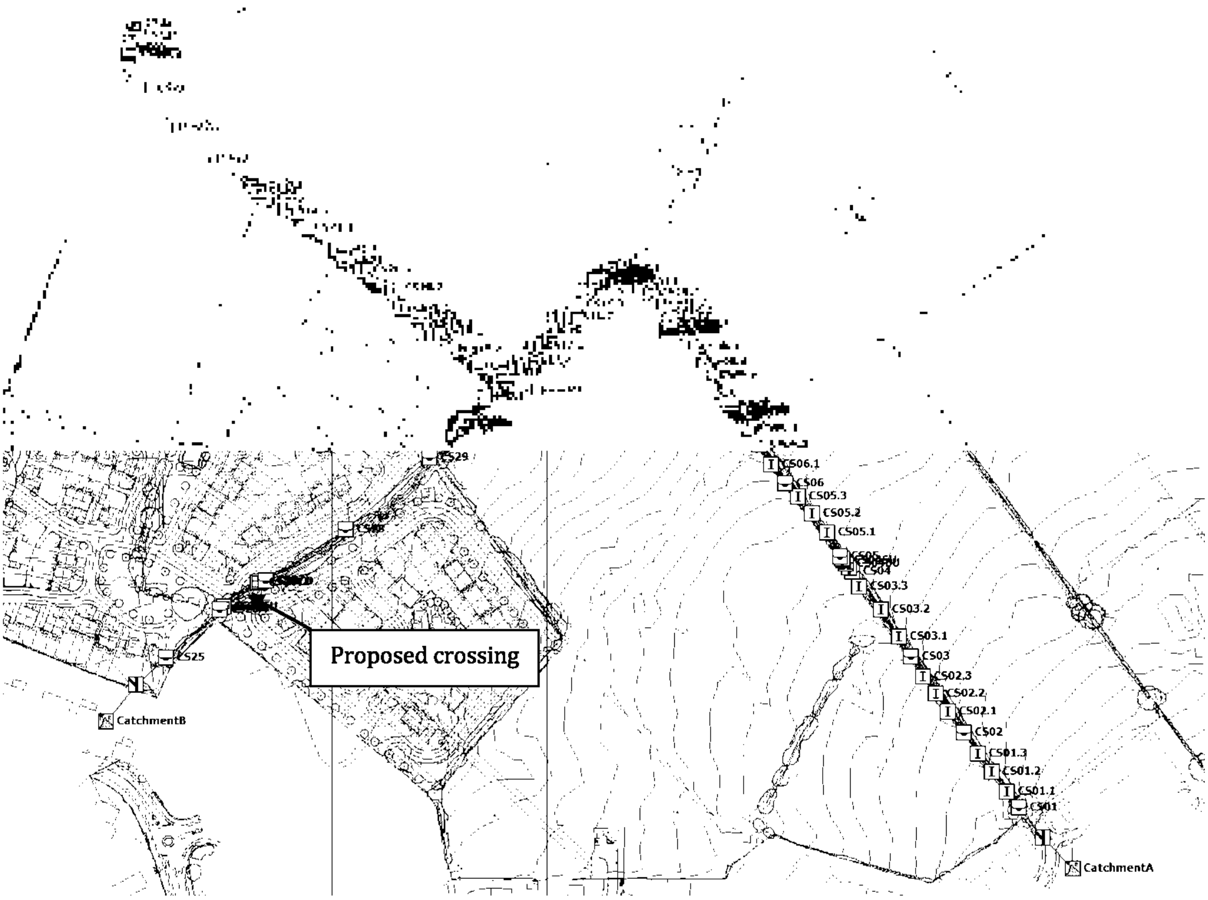


Figure 5: Proposed ISIS model schematic with new crossing

[redacted]				
[redacted]	115.96	116.02	116.06	116.10
[redacted]	114.79	114.85	114.89	114.92
[redacted]	113.39	113.45	113.51	113.53
[redacted]	112.38	112.66	112.88	112.92
[redacted]	111.36	111.40	111.44	111.47
[redacted]	109.89	109.92	109.97	110.00
[redacted]	108.37	108.65	109.08	109.40
[redacted]	107.86	107.91	107.95	107.97
[redacted]	107.26	107.51	107.59	107.62
[redacted]	106.88	106.92	106.97	106.99
[redacted]	106.39	106.44	106.49	106.51
[redacted]	105.60	105.85	106.15	106.23
[redacted]	105.58	105.84	106.15	106.23
[redacted]	105.14	105.19	105.22	105.25
[redacted]	103.91	103.92	103.94	103.95
[redacted]	103.40	103.45	103.50	103.52
[redacted]	103.40	103.45	103.50	103.52
[redacted]	102.81	102.88	102.93	103.14
[redacted]	102.52	102.63	102.84	103.14
[redacted]	102.40	102.58	102.83	103.14
[redacted]	101.30	101.39	101.44	101.45
[redacted]	101.22	101.31	101.35	101.36
[redacted]	105.85	105.93	106.03	106.13
[redacted]	105.61	105.76	105.91	106.06
[redacted]	105.09	105.19	105.27	105.31
[redacted]	104.81	104.85	104.89	104.92
[redacted]	104.14	104.23	104.34	104.40
[redacted]	103.99	104.14	104.27	104.35
[redacted]	103.63	103.72	103.81	103.85
[redacted]	103.40	103.45	103.50	103.52

Table 3: Peak 20%, 3.3%, 1% and 0.1% AEP existing water levels

[redacted]				
[redacted]	115.96	116.02	116.06	116.10
[redacted]	114.79	114.85	114.89	114.92
[redacted]	113.39	113.45	113.51	113.53
[redacted]	112.38	112.66	112.88	112.92
[redacted]	111.35	111.40	111.45	111.47
[redacted]	109.89	109.92	109.97	110.00
[redacted]	108.37	108.65	109.08	109.40
[redacted]	107.86	107.91	107.95	107.97
[redacted]	107.26	107.50	107.59	107.62
[redacted]	106.88	106.92	106.97	106.99
[redacted]	106.39	106.44	106.49	106.51
[redacted]	105.60	105.85	106.15	106.23
[redacted]	105.58	105.84	106.15	106.23
[redacted]	105.14	105.19	105.22	105.25
[redacted]	103.91	103.92	103.94	103.95
[redacted]	103.40	103.45	103.50	103.53
[redacted]	103.40	103.45	103.50	103.53
[redacted]	102.81	102.88	102.93	103.15
[redacted]	102.52	102.63	102.84	103.14
[redacted]	102.41	102.58	102.83	103.14
[redacted]	101.30	101.39	101.44	101.45
[redacted]	101.22	101.31	101.35	101.36
[redacted]	105.86	105.95	106.06	106.15
[redacted]	105.67	105.81	105.97	106.09
[redacted]	105.09	105.19	105.28	105.31
[redacted]	104.81	104.85	104.89	104.92
[redacted]	104.14	104.24	104.34	104.41
[redacted]	103.99	104.14	104.28	104.36
[redacted]	103.63	103.72	103.81	103.86
[redacted]	103.40	103.45	103.50	103.53

Table 4: Peak 20%, 3.3%, 1% and 0.1% AEP proposed water levels

6.0 LOW FLOW ANALYSIS

6.1 In order to determine a typical water level above which to set the levels of the surface water outfalls, a low flow analysis was undertaken in accordance with the Institute of Hydrology Report number 108 (IH 108). The analysis included the soil HOST classification, the UK Hydrometric Register and the Flood Estimation Handbook (FEH) CD-ROM.

6.2 An extract from the soil HOST maps is shown in Figure 6, indicating that the soil classification for the catchment is 711m.

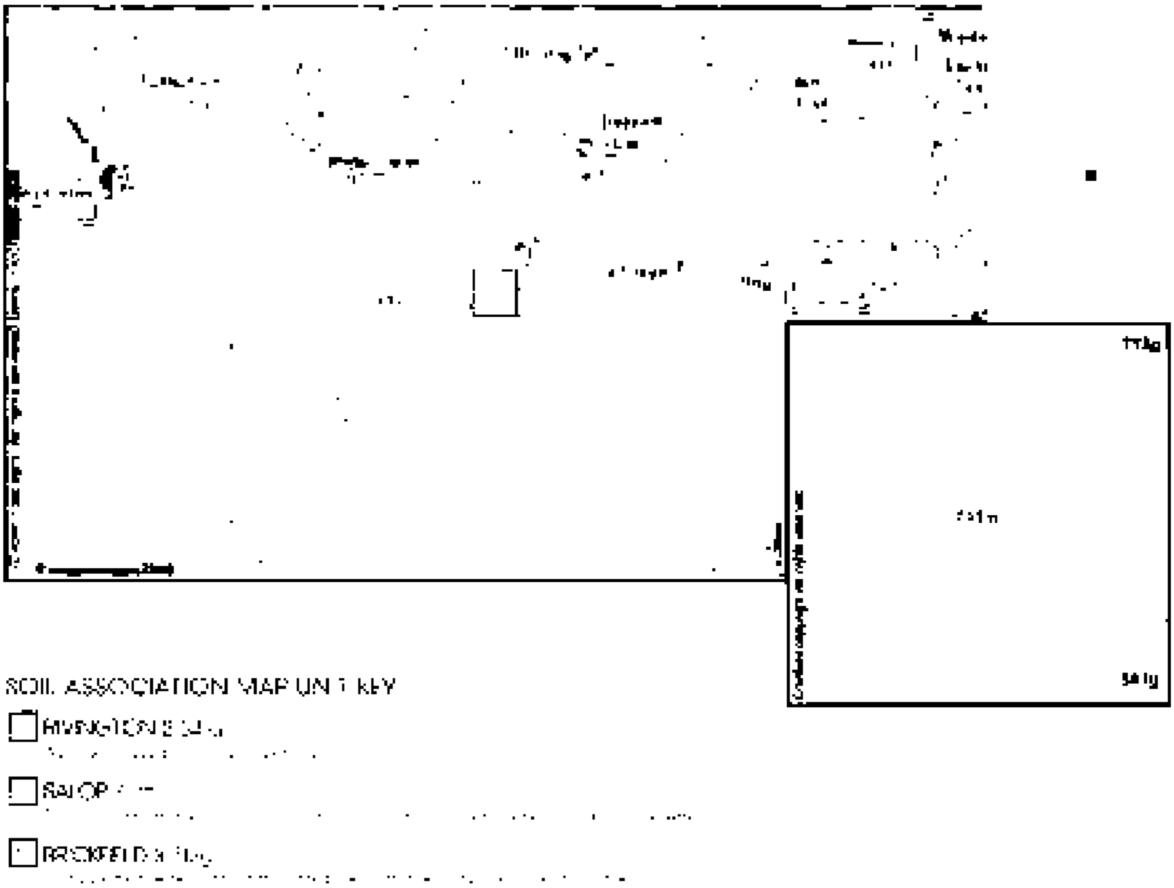


Figure 6: Soil HOST map classification

6.3 The FEH CD-ROM gives the Catchment Area = 0.52km² and standard average annual rainfall, SAAR = 1200mm. The FEH catchment is shown in Figure 7.

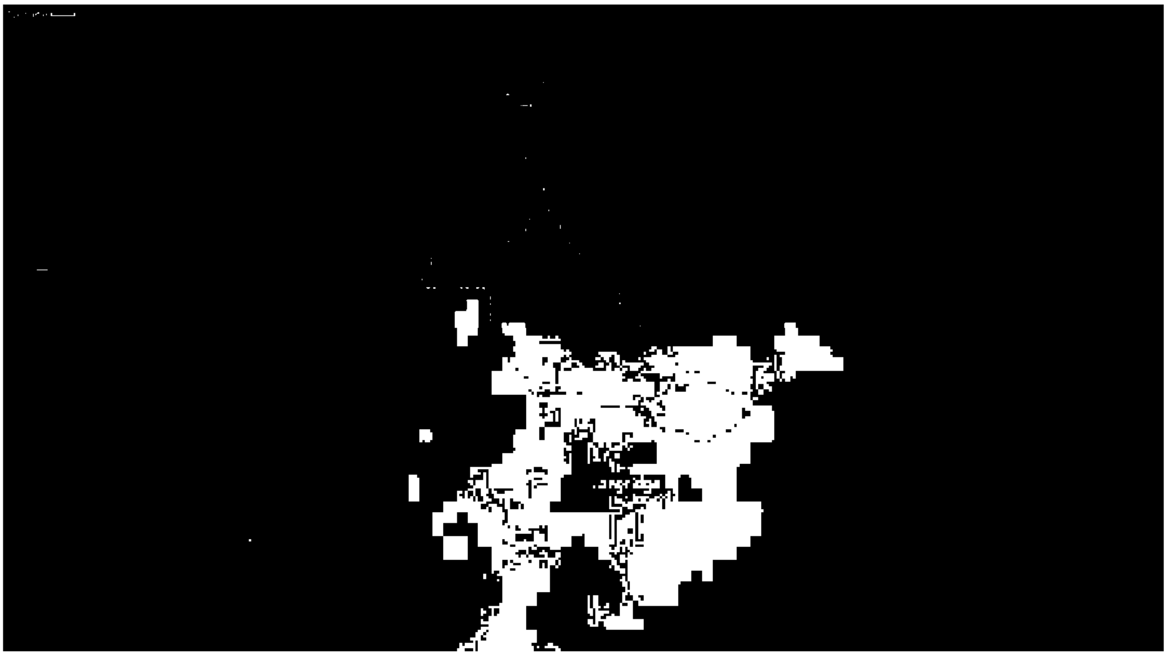


Figure 7: FEH CD-ROM catchment

6.4 From UK Hydrometric Register River Hodder @ Hodder Place (Station Number 71008):

Potential evaporation, PE = 600mm

6.5 From Institute of Hydrology (IH) report 108, section 7.3.2:

Annual Average Runoff Depth (AARD) = SAAR – Losses
Losses = r x PE where r=1 for SAAR>= 850mm

AARD = 1200 – 600
AARD = 600mm

Convert AARD to Mean Flow (MF)

MF = AARD x AREA x (3.17 x 10^{-5})
MF = 600 x 0.52 x 3.17 x 10^{-5}
MF = 0.0099 m^3/s

6.6 From IH 108 Appendix 4

Soil type 711m gives the 95 percentile 1-day flow, Q95(1), of 10.7% of mean flow, therefore

Q95(1) = MF x 10.7/100
Q95(1) = 0.0011 m^3/s

6.7 From IH 108 Table 7.1:

Curve 10: Q95(1) percentage of 10.0% is closest to Q95(1) of 10.7% given by soil

[redacted]		
[redacted]	428.96	0.0425
[redacted]	303.93	0.0301
[redacted]	52.46	0.0052
[redacted]	21.25	0.0021
[redacted]	13.75	0.0014
[redacted]	10.00	0.0010
[redacted]	5.89	0.0006

Table 5: Flow duration

6.8 Flow duration curve is shown in Figure 8.

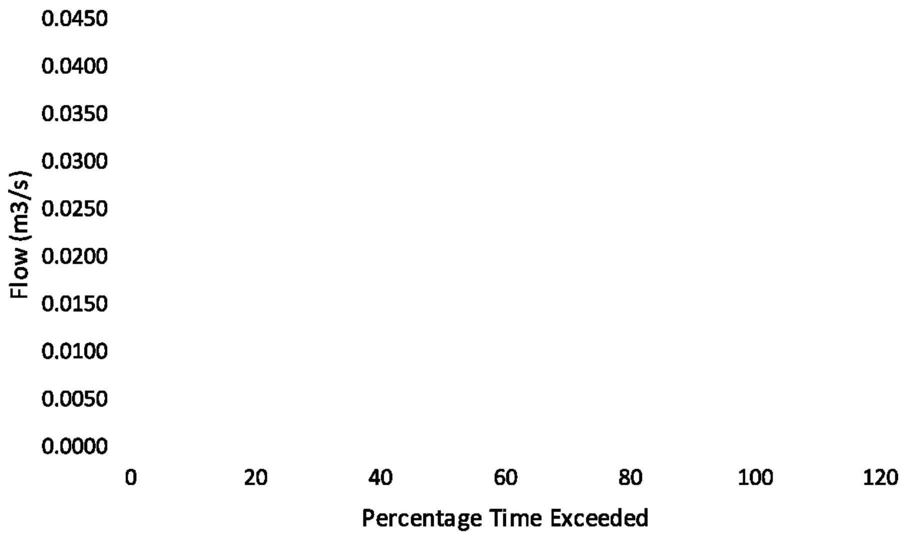


Figure 8: Flow Duration Curve

6.9 The Q95(1) flow of 0.001 m^3/s is too low to be run in the hydraulic model, and so a Manning's equation calculation has been undertaken on a typical cross section to determine the typical water level. The typical cross section is shown in Figure 9.

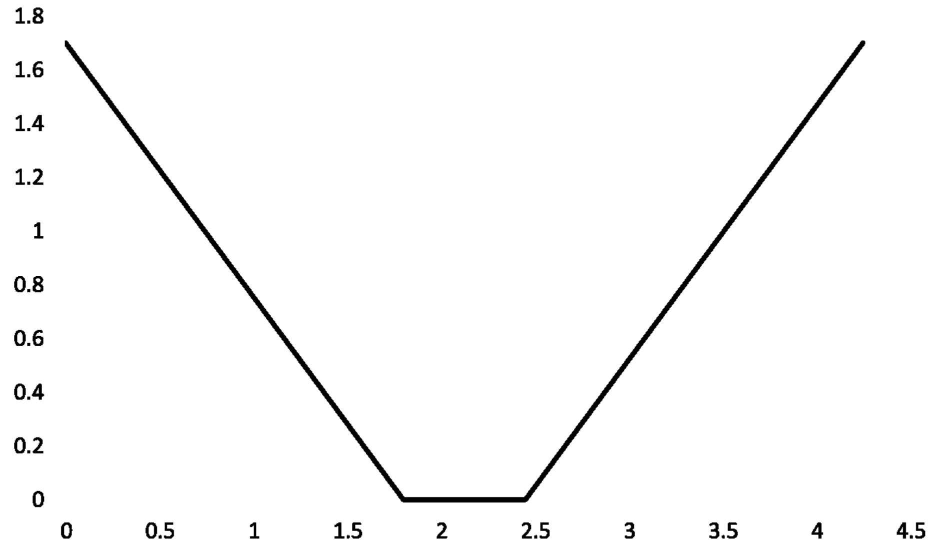


Figure 9: Typical cross section

6.10 Manning's equation is as follows:

$$Q = \frac{AR^{2/3}\sqrt{S}}{n}$$

where Q is flow, A is area of flow, R is hydraulic radius and S is gradient.

6.11 Using the average gradient of 0.025 and a Manning's roughness coefficient of 0.06, Manning's equation yields:

$$A = \frac{Qn}{R^{2/3}\sqrt{S}}$$

$$A = \frac{0.01 \times 0.06}{0.011^{2/3}\sqrt{0.025}}$$

$$A = 0.008\, m^3$$

6.12 The flow area of 0.008m³ corresponds to a depth in the typical channel cross section of 0.012m. It is therefore recommended that the invert levels of surface water outfalls be set at 300mm above this level.

7.0 CONCLUSIONS

6.1 The hydraulic assessment has indicated that peak water levels in the watercourses remain largely within banks for events up to the 1% AEP plus climate change.

6.2 A thorough sensitivity analysis of key parameters has been undertaken and has shown that the model results are not significantly affected by changes in those parameters.

6.3 A low flow analysis was undertaken to determine the Q95(1) flow. The Q95(1) flow was calculated to be 0.001m^3/s.

6.4 A Manning's equation calculation provided a typical depth in the channel of 0.012m. It is recommended that the invert levels of the surface water outfalls be set at 300mm above the Q95(1) water level.

BIBLIOGRAPHY & REFERENCES

National Planning Policy Framework, CLG (2012).
Planning Practice Guidance, CLG (2014)
Institute of Hydrology Report No. 108 (1992)

Web-based References

Bingmaps – http://www.bing.com/Maps/
British Geological Survey – http://www.bgs.ac.uk/opengeoscience/home.html
Chronology of British Hydrological Events – www.dundee.ac.uk/
CIRIA – http://www.ciria.org/
Cranfield University – http://www.landis.org.uk/soilscapes/
Environment Agency – www.environment-agency.gov.uk/
FloodProBE – http://www.floodprobe.eu/
Flood Forum – http://www.floodforum.org.uk/
Flood London – http://www.floodlondon.com/
Flood Resilience Group – http://www.floodresiliencegroup.org/frg/
Fylde Borough Council– http://www.fylde.gov.uk/
Google Maps – http://maps.google.co.uk/
Lancashire County Council- http://www.lancashire.gov.uk/home/2010/classic/index.asp
Streetmap – http://www.streetmap.co.uk/
United Utilities - http://www.unitedutilities.com/default.aspx

Appendix D
Site Investigation

soiltechnics

Proposed residential development
Land east of Chipping Lane
Longridge, Preston

Ground Investigation Report
(Phase 1)

t e: w:

soiltechnics

Proposed residential development
Phase 1
Land East of Chipping Lane
Longridge
Preston
PR3 2NA

GROUND INVESTIGATION REPORT

Soiltechnics Ltd. Ivy Mill Business Centre, Crown Street, Failsworth, Manchester, M35 9BG
Tel: (0161) 9470270 **E-mail: mail@soiltechnics.net**

Report originators

Prepared by [redacted]

[redacted] B.Eng. (Hons)., MSc., AIEMA — [redacted] Geo-environmental Engineer, Soiltechnics Limited

Supervised/ Reviewed by [redacted]

[redacted] B.Sc. (Hons)., FGS., MIEnvSc. — [redacted] Associate Director, Soiltechnics Limited

Reviewed by [redacted]

[redacted] B.Sc. (Hons)., CEnv., FGS — [redacted] Director, Soiltechnics Limited

soiltechnics

Proposed residential development
Land east of Chipping Lane
Longridge, Preston

Ground Investigation Report
(Phase 2)

t e: w:

soiltechnics

Proposed residential development
Phase 2
Land East of Chipping Lane
Longridge
Preston
PR3 2NA

GROUND INVESTIGATION REPORT

Soiltechnics Ltd. Ivy Mill Business Centre, Crown Street, Failsworth, Manchester, M35 9BG
Tel: (0161) 9470270 E-mail: mail@soiltechnics.net

Report originators

Prepared by [redacted]

[redacted] B.Sc,(Hons) (Open), MIEnvSc. [redacted] Senior geo-environmental Engineer, Soiltechnics Limited

Supervised/ Reviewed by [redacted]

[redacted] B.Sc. (Hons)., FGS., MIEnvSc. [redacted] Associate Director, Soiltechnics Limited

Reviewed by [redacted]

[redacted] B.Sc. (Hons)., CEnv., FGS [redacted] Director, Soiltechnics Limited

Appendix E
MicroDrainage Simulations

Storm Water Network 1

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Surface Network 1

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	18.800	Add Flow / Climate Change (%)	0
Ratio R	0.281	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Surface Network 1

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	34.856	0.087	400.6	0.168	5.00	0.0	0.600	o	1200	Pipe/Conduit	
1.001	14.100	0.028	503.6	0.034	0.00	0.0	0.600	o	1500	Pipe/Conduit	
2.000	26.078	0.153	170.4	0.051	5.00	0.0	0.600	o	225	Pipe/Conduit	
2.001	26.997	0.429	62.9	0.016	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.002	9.581	0.056	171.1	0.050	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.003	30.643	0.361	84.9	0.115	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	12.868	0.026	494.9	0.039	0.00	0.0	0.600	o	1500	Pipe/Conduit	
3.000	37.925	0.181	209.5	0.075	5.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.31	103.006	0.168	0.0	0.0	0.0	1.86	2106.9	22.7
1.001	50.00	5.44	102.619	0.202	0.0	0.0	0.0	1.90	3365.7	27.4
2.000	50.00	5.44	104.865	0.051	0.0	0.0	0.0	1.00	39.7	6.9
2.001	50.00	5.71	104.712	0.067	0.0	0.0	0.0	1.65	65.7	9.1
2.002	50.00	5.87	104.283	0.117	0.0	0.0	0.0	1.00	39.6	15.8
2.003	50.00	6.23	104.226	0.232	0.0	0.0	0.0	1.42	56.5	31.4
1.002	50.00	6.34	102.591	0.473	0.0	0.0	0.0	1.92	3395.2	64.1
3.000	50.00	5.58	103.977	0.075	0.0	0.0	0.0	1.08	76.5	10.2

Network Design Table for Surface Network 1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
3.001	12.524	0.031	404.0	0.009	0.00	0.0	0.600	o	450	Pipe/Conduit	🔒
1.003	20.839	0.042	496.2	0.030	0.00	0.0	0.600	o	1500	Pipe/Conduit	🔒
1.004	19.697	0.039	505.1	0.049	0.00	0.0	0.600	o	1500	Pipe/Conduit	🔒
1.005	11.281	0.023	490.5	0.000	0.00	0.0	0.600	o	1500	Pipe/Conduit	🔒
1.006	21.474	0.043	499.4	0.000	0.00	0.0	0.600	o	1500	Pipe/Conduit	🔒
1.007	11.233	0.022	510.6	0.057	0.00	0.0	0.600	o	1500	Pipe/Conduit	🔒
1.008	47.046	0.094	500.5	0.094	0.00	0.0	0.600	o	1500	Pipe/Conduit	🔒
4.000	32.098	0.597	53.8	0.044	5.00	0.0	0.600	o	225	Pipe/Conduit	🔒
4.001	27.069	0.068	398.1	0.084	0.00	0.0	0.600	o	525	Pipe/Conduit	🔒
1.009	39.199	0.080	490.0	0.022	0.00	0.0	0.600	o	1500	Pipe/Conduit	🔒
1.010	20.544	0.041	501.1	0.068	0.00	0.0	0.600	o	1500	Pipe/Conduit	🔒
5.000	31.155	0.663	47.0	0.033	5.00	0.0	0.600	o	225	Pipe/Conduit	🔒
5.001	24.755	0.688	36.0	0.068	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
5.002	7.704	0.198	38.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
5.003	6.655	0.139	47.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
6.000	37.767	1.511	25.0	0.054	5.00	0.0	0.600	o	225	Pipe/Conduit	🔒
6.001	27.458	1.016	27.0	0.068	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
3.001	50.00	5.79	103.646	0.084	0.0	0.0	0.0	1.01	159.9	11.4
1.003	49.61	6.52	102.565	0.587	0.0	0.0	0.0	1.92	3390.9	78.9
1.004	49.07	6.69	102.523	0.636	0.0	0.0	0.0	1.90	3360.7	84.5
1.005	48.78	6.79	102.484	0.636	0.0	0.0	0.0	1.93	3410.6	84.5
1.006	48.22	6.98	102.461	0.636	0.0	0.0	0.0	1.91	3379.8	84.5
1.007	47.93	7.08	102.418	0.693	0.0	0.0	0.0	1.89	3342.3	90.0
1.008	46.78	7.49	102.396	0.787	0.0	0.0	0.0	1.91	3376.1	99.7
4.000	50.00	5.30	104.242	0.044	0.0	0.0	0.0	1.79	71.1	6.0
4.001	50.00	5.70	103.345	0.128	0.0	0.0	0.0	1.12	241.7	17.3
1.009	45.88	7.83	102.302	0.937	0.0	0.0	0.0	1.93	3412.3	116.4
1.010	45.42	8.00	102.222	1.005	0.0	0.0	0.0	1.91	3374.1	123.6
5.000	50.00	5.27	108.172	0.033	0.0	0.0	0.0	1.91	76.1	4.5
5.001	50.00	5.46	107.509	0.101	0.0	0.0	0.0	2.19	87.0	13.7
5.002	50.00	5.52	106.821	0.101	0.0	0.0	0.0	2.10	83.6	13.7
5.003	50.00	5.58	106.624	0.101	0.0	0.0	0.0	1.90	75.4	13.7
6.000	50.00	5.24	111.159	0.054	0.0	0.0	0.0	2.63	104.5	7.3
6.001	50.00	5.42	109.648	0.122	0.0	0.0	0.0	2.53	100.5	16.5

Network Design Table for Surface Network 1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
7.000	39.385	0.394	100.0	0.083	5.00	0.0	0.600	o	225	Pipe/Conduit	
8.000	20.526	1.069	19.2	0.121	5.00	0.0	0.600	o	225	Pipe/Conduit	
7.001	47.242	0.304	155.4	0.089	0.00	0.0	0.600	o	300	Pipe/Conduit	
7.002	26.364	0.195	135.2	0.100	0.00	0.0	0.600	o	750	Pipe/Conduit	
6.002	27.056	0.200	135.3	0.014	0.00	0.0	0.600	o	750	Pipe/Conduit	
6.003	35.837	0.246	145.7	0.092	0.00	0.0	0.600	o	750	Pipe/Conduit	
6.004	20.674	0.056	369.2	0.034	0.00	0.0	0.600	o	750	Pipe/Conduit	
6.005	30.374	0.335	90.7	0.000	0.00	0.0	0.600	o	750	Pipe/Conduit	
6.006	8.611	0.035	246.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
5.004	6.888	0.053	130.0	0.045	0.00	0.0	0.600	o	450	Pipe/Conduit	
5.005	30.420	0.317	96.0	0.022	0.00	0.0	0.600	o	450	Pipe/Conduit	
5.006	7.929	0.091	87.1	0.021	0.00	0.0	0.600	o	450	Pipe/Conduit	
5.007	19.595	0.338	58.0	0.033	0.00	0.0	0.600	o	450	Pipe/Conduit	
5.008	12.502	0.272	46.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
5.009	9.280	0.023	403.5	0.087	0.00	0.0	0.600	o	450	Pipe/Conduit	
5.010	11.131	0.028	397.5	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
5.011	19.961	0.139	143.6	0.016	0.00	0.0	0.600	o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
7.000	50.00	5.50	108.550	0.083	0.0	0.0	0.0	1.31	52.0	11.2
8.000	50.00	5.11	110.650	0.121	0.0	0.0	0.0	3.00	119.3	16.4
7.001	50.00	6.13	108.081	0.293	0.0	0.0	0.0	1.26	89.0	39.7
7.002	50.00	6.31	107.327	0.393	0.0	0.0	0.0	2.41	1062.6	53.2
6.002	49.68	6.50	107.132	0.529	0.0	0.0	0.0	2.40	1062.2	71.2
6.003	48.88	6.76	106.932	0.621	0.0	0.0	0.0	2.32	1023.4	82.2
6.004	48.17	6.99	106.686	0.655	0.0	0.0	0.0	1.45	640.8	85.5
6.005	47.67	7.17	106.630	0.655	0.0	0.0	0.0	2.94	1298.8	85.5
6.006	47.36	7.28	106.295	0.655	0.0	0.0	0.0	1.29	205.4	85.5
5.004	47.18	7.34	106.260	0.801	0.0	0.0	0.0	1.78	283.4	102.3
5.005	46.51	7.59	106.207	0.823	0.0	0.0	0.0	2.08	330.1	103.7
5.006	46.35	7.65	105.890	0.844	0.0	0.0	0.0	2.18	346.6	105.9
5.007	46.03	7.77	105.799	0.877	0.0	0.0	0.0	2.67	425.3	109.3
5.008	45.85	7.84	105.461	0.877	0.0	0.0	0.0	3.01	477.9	109.3
5.009	45.46	7.99	105.189	0.964	0.0	0.0	0.0	1.01	160.0	118.7
5.010	45.00	8.17	105.166	0.964	0.0	0.0	0.0	1.01	161.2	118.7
5.011	44.52	8.37	105.138	0.980	0.0	0.0	0.0	1.69	269.5	118.7

Network Design Table for Surface Network 1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
5.012	13.450	0.157	85.7	0.050	0.00	0.0	0.600	o	450	Pipe/Conduit	🔒
9.000	41.859	1.231	34.0	0.052	5.00	0.0	0.600	o	225	Pipe/Conduit	🔒
9.001	39.560	1.364	29.0	0.090	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
9.002	13.898	0.613	22.7	0.036	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
10.000	25.064	0.135	185.7	0.000	5.00	0.0	0.600	o	375	Pipe/Conduit	🔒
9.003	48.787	1.149	42.5	0.089	0.00	0.0	0.600	o	375	Pipe/Conduit	🔒
5.013	18.119	0.045	402.6	0.011	0.00	0.0	0.600	o	450	Pipe/Conduit	🔒
5.014	27.409	0.069	397.2	0.043	0.00	0.0	0.600	o	450	Pipe/Conduit	🔒
5.015	14.789	0.037	399.7	0.090	0.00	0.0	0.600	o	450	Pipe/Conduit	🔒
5.016	6.471	0.017	380.6	0.011	0.00	0.0	0.600	o	450	Pipe/Conduit	🔒
11.000	24.649	0.325	75.8	0.034	5.00	0.0	0.600	o	225	Pipe/Conduit	🔒
5.017	17.659	0.044	401.3	0.015	0.00	0.0	0.600	o	450	Pipe/Conduit	🔒
5.018	66.144	0.165	400.9	0.090	0.00	0.0	0.600	o	525	Pipe/Conduit	🔒
5.019	62.798	0.157	400.0	0.119	0.00	0.0	0.600	o	525	Pipe/Conduit	🔒
5.020	26.670	0.067	398.1	0.035	0.00	0.0	0.600	o	1500	Pipe/Conduit	🔒
5.021	39.257	0.098	400.6	0.000	0.00	0.0	0.600	o	1500	Pipe/Conduit	🔒

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
5.012	44.28	8.47	104.999	1.030	0.0	0.0	0.0	2.20	349.5	123.5
9.000	50.00	5.31	108.448	0.052	0.0	0.0	0.0	2.25	89.5	7.0
9.001	50.00	5.58	107.217	0.142	0.0	0.0	0.0	2.44	97.0	19.2
9.002	50.00	5.66	105.853	0.178	0.0	0.0	0.0	2.76	109.7	24.1
10.000	50.00	5.31	105.375	0.000	0.0	0.0	0.0	1.33	146.5	0.0
9.003	50.00	5.96	105.240	0.267	0.0	0.0	0.0	2.79	307.9	36.2
5.013	43.58	8.77	104.016	1.308	0.0	0.0	0.0	1.01	160.2	154.4
5.014	42.58	9.22	103.971	1.351	0.0	0.0	0.0	1.01	161.3	155.8
5.015	42.07	9.47	103.902	1.441	0.0	0.0	0.0	1.01	160.7«	164.2
5.016	41.85	9.57	103.865	1.452	0.0	0.0	0.0	1.04	164.8	164.6
11.000	50.00	5.27	104.399	0.034	0.0	0.0	0.0	1.50	59.8	4.6
5.017	41.26	9.86	103.848	1.501	0.0	0.0	0.0	1.01	160.4«	167.7
5.018	39.40	10.85	103.729	1.591	0.0	0.0	0.0	1.11	240.8	169.8
5.019	37.82	11.79	103.564	1.710	0.0	0.0	0.0	1.11	241.1	175.1
5.020	37.49	12.00	102.432	1.745	0.0	0.0	0.0	2.14	3788.4	177.2
5.021	37.02	12.31	102.365	1.745	0.0	0.0	0.0	2.14	3776.3	177.2

Network Design Table for Surface Network 1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
5.022	34.015	0.085	400.2	0.076	0.00	0.0	0.600	o	1500	Pipe/Conduit	🔒
1.011	44.767	0.089	503.0	0.000	0.00	0.0	0.600	o	1500	Pipe/Conduit	🔒
1.012	8.914	0.053	168.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	🔒

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
5.022	36.62	12.57	102.267	1.821	0.0	0.0	0.0	2.14	3778.3	180.6
1.011	36.05	12.96	102.182	2.826	0.0	0.0	0.0	1.91	3367.6	275.9
1.012	35.88	13.09	102.093	2.826	0.0	0.0	0.0	1.21	85.5«	275.9

Online Controls for Surface Network 1

Orifice Manhole: S110, DS/PN: 6.006, Volume (m^3): 21.1

Diameter (m) 0.247 Discharge Coefficient 0.600 Invert Level (m) 106.295

Hydro-Brake® Optimum Manhole: S13, DS/PN: 1.012, Volume (m^3): 92.9

Unit Reference	MD-SHE-0278-5000-2200-5000
Design Head (m)	2.200
Design Flow (l/s)	50.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	278
Invert Level (m)	102.093
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	2100

Control Points	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	2.200	50.0
Flush-Flo™	0.658	49.9
Kick-Flo®	1.428	40.6
Mean Flow over Head Range	-	43.2

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	8.7	1.200	46.4	3.000	58.1	7.000	87.6
0.200	28.7	1.400	41.7	3.500	62.6	7.500	90.6
0.300	45.2	1.600	42.9	4.000	66.7	8.000	93.5
0.400	47.9	1.800	45.4	4.500	70.7	8.500	96.3
0.500	49.3	2.000	47.7	5.000	74.4	9.000	99.0
0.600	49.9	2.200	50.0	5.500	77.9	9.500	101.6
0.800	49.6	2.400	52.1	6.000	81.3		
1.000	48.5	2.600	54.2	6.500	84.5		

Storage Structures for Surface Network 1

Tank or Pond Manhole: S13, DS/PN: 1.012

Invert Level (m) 103.650

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	947.9	0.200	1029.2	0.400	1113.4	0.600	1200.5
0.100	988.1	0.300	1070.9	0.500	1156.6	0.750	1267.7

Manhole Schedules for Surface Network 1

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
S1	105.233	2.227	Open Manhole	2400	1.000	103.006	1200				
S2	105.924	3.305	Open Manhole	2400	1.001	102.619	1500	1.000	102.919	1200	
S15	106.290	1.425	Open Manhole	1350	2.000	104.865	225				
S16	106.358	1.646	Open Manhole	1350	2.001	104.712	225	2.000	104.712	225	
S17	105.854	1.571	Open Manhole	1350	2.002	104.283	225	2.001	104.283	225	
S18	105.655	1.429	Open Manhole	1500	2.003	104.226	225	2.002	104.227	225	1
S3	105.961	3.370	Open Manhole	2400	1.002	102.591	1500	1.001	102.591	1500	
								2.003	103.865	225	
S19	105.531	1.554	Open Manhole	1800	3.000	103.977	300				
S20	105.820	2.174	Open Manhole	1500	3.001	103.646	450	3.000	103.796	300	
S4	105.808	3.243	Open Manhole	2700	1.003	102.565	1500	1.002	102.565	1500	
								3.001	103.615	450	
S5	105.622	3.099	Open Manhole	2400	1.004	102.523	1500	1.003	102.523	1500	
S6	105.847	3.363	Open Manhole	2400	1.005	102.484	1500	1.004	102.484	1500	
S7	105.909	3.448	Open Manhole	2400	1.006	102.461	1500	1.005	102.461	1500	
S8	105.721	3.303	Open Manhole	2400	1.007	102.418	1500	1.006	102.418	1500	
S9	105.581	3.185	Open Manhole	2400	1.008	102.396	1500	1.007	102.396	1500	
S21	105.667	1.425	Open Manhole	1350	4.000	104.242	225				
S22	105.259	1.914	Open Manhole	1800	4.001	103.345	525	4.000	103.645	225	
S10	105.002	2.700	Open Manhole	3000	1.009	102.302	1500	1.008	102.302	1500	
								4.001	103.277	525	
S11	104.922	2.700	Open Manhole	3000	1.010	102.222	1500	1.009	102.222	1500	
S23	109.597	1.425	Open Manhole	1350	5.000	108.172	225				
S24	108.947	1.438	Open Manhole	1500	5.001	107.509	225	5.000	107.509	225	
S25	108.247	1.426	Open Manhole	1350	5.002	106.821	225	5.001	106.821	225	
S26	108.049	1.426	Open Manhole	1350	5.003	106.624	225	5.002	106.623	225	
S105	112.727	1.568	Open Manhole	1500	6.000	111.159	225				
S106	111.782	2.134	Open Manhole	1350	6.001	109.648	225	6.000	109.648	225	
S101	110.167	1.617	Open Manhole	1350	7.000	108.550	225				
S102	112.243	1.593	Open Manhole	1500	8.000	110.650	225				
S103	111.709	3.628	Open Manhole	2100	7.001	108.081	300	7.000	108.156	225	
								8.000	109.581	225	1425
S104	110.918	3.591	Open Manhole	2400	7.002	107.327	750	7.001	107.777	300	
S107	111.491	4.359	Open Manhole	2400	6.002	107.132	750	6.001	108.632	225	975
								7.002	107.132	750	
S108	111.053	4.121	Open Manhole	2400	6.003	106.932	750	6.002	106.932	750	
S109	110.539	3.853	Open Manhole	2400	6.004	106.686	750	6.003	106.686	750	
S109A	110.009	3.379	Open Manhole	1800	6.005	106.630	750	6.004	106.630	750	

Manhole Schedules for Surface Network 1

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S110	108.200	1.905	Open Manhole	2400	6.006	106.295	450	6.005	106.295	750	
S27	107.924	1.664	Open Manhole	1500	5.004	106.260	450	5.003	106.485	225	
								6.006	106.260	450	
S28	107.857	1.650	Open Manhole	1500	5.005	106.207	450	5.004	106.207	450	
S29	107.540	1.650	Open Manhole	1500	5.006	105.890	450	5.005	105.890	450	
S30	107.449	1.650	Open Manhole	1500	5.007	105.799	450	5.006	105.799	450	
S31	107.646	2.185	Open Manhole	1500	5.008	105.461	450	5.007	105.461	450	
S32	107.569	2.380	Open Manhole	1500	5.009	105.189	450	5.008	105.189	450	
S33	107.430	2.264	Open Manhole	1500	5.010	105.166	450	5.009	105.166	450	
S34	107.241	2.103	Open Manhole	1500	5.011	105.138	450	5.010	105.138	450	
S35	106.909	1.910	Open Manhole	1500	5.012	104.999	450	5.011	104.999	450	
S46	109.881	1.433	Open Manhole	1350	9.000	108.448	225				
S47	108.671	1.454	Open Manhole	1350	9.001	107.217	225	9.000	107.217	225	
S48	107.297	1.444	Open Manhole	1350	9.002	105.853	225	9.001	105.853	225	
S201	107.005	1.630	Open Manhole	2100	10.000	105.375	375				
S49	106.894	1.654	Open Manhole	1350	9.003	105.240	375	9.002	105.240	225	
								10.000	105.240	375	
S36	106.895	2.879	Open Manhole	1800	5.013	104.016	450	5.012	104.842	450	826
								9.003	104.091	375	
S37	106.951	2.980	Open Manhole	1800	5.014	103.971	450	5.013	103.971	450	
S38	106.608	2.706	Open Manhole	1800	5.015	103.902	450	5.014	103.902	450	
S39	106.386	2.521	Open Manhole	1800	5.016	103.865	450	5.015	103.865	450	
S50	105.824	1.425	Open Manhole	1350	11.000	104.399	225				
S40	106.262	2.414	Open Manhole	1800	5.017	103.848	450	5.016	103.848	450	
								11.000	104.074	225	1
S41	105.972	2.243	Open Manhole	1800	5.018	103.729	525	5.017	103.804	450	
S42	105.729	2.165	Open Manhole	1800	5.019	103.564	525	5.018	103.564	525	
S43	105.566	3.134	Open Manhole	2700	5.020	102.432	1500	5.019	103.407	525	
S44	105.250	2.885	Open Manhole	2700	5.021	102.365	1500	5.020	102.365	1500	
S45	104.968	2.701	Open Manhole	3000	5.022	102.267	1500	5.021	102.267	1500	
S12	104.882	2.701	Open Manhole	3000	1.011	102.182	1500	1.010	102.181	1500	
								5.022	102.182	1500	
S13	104.793	2.700	Open Manhole	3000	1.012	102.093	300	1.011	102.093	1500	
S14	102.473	0.433	Open Manhole	600		OUTFALL		1.012	102.040	300	

Manhole Schedules for Surface Network 1

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S1	360045.987	438005.971	360045.987	438005.971	Required	
S2	360075.017	437986.678	360075.017	437986.678	Required	
S15	360020.388	437954.416	360020.388	437954.416	Required	
S16	360046.459	437953.809	360046.459	437953.809	Required	
S17	360073.319	437951.095	360073.319	437951.095	Required	
S18	360082.491	437953.866	360082.491	437953.866	Required	
S3	360088.830	437983.846	360088.830	437983.846	Required	
S19	360117.741	438028.822	360117.741	438028.822	Required	
S20	360104.068	437993.447	360104.068	437993.447	Required	
S4	360101.424	437981.205	360101.424	437981.205	Required	
S5	360121.836	437977.010	360121.836	437977.010	Required	
S6	360132.313	437993.689	360132.313	437993.689	Required	
S7	360137.882	438003.500	360137.882	438003.500	Required	
S8	360149.776	438021.379	360149.776	438021.379	Required	
S9	360154.725	438031.463	360154.725	438031.463	Required	

Manhole Schedules for Surface Network 1

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S21	360226.587	438033.057	360226.587	438033.057	Required	
S22	360201.714	438053.346	360201.714	438053.346	Required	
S10	360180.848	438070.590	360180.848	438070.590	Required	
S11	360204.062	438102.176	360204.062	438102.176	Required	
S23	360304.757	437915.600	360304.757	437915.600	Required	
S24	360283.654	437892.680	360283.654	437892.680	Required	
S25	360269.253	437872.545	360269.253	437872.545	Required	
S26	360262.459	437868.913	360262.459	437868.913	Required	
S105	360402.238	437825.920	360402.238	437825.920	Required	
S106	360366.337	437837.645	360366.337	437837.645	Required	
S101	360330.611	437925.095	360330.611	437925.095	Required	
S102	360381.960	437894.730	360381.960	437894.730	Required	
S103	360363.102	437902.834	360363.102	437902.834	Required	
S104	360338.786	437862.331	360338.786	437862.331	Required	
S107	360338.930	437835.967	360338.930	437835.967	Required	

Manhole Schedules for Surface Network 1

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S108	360317.301	437819.712	360317.301	437819.712	Required	
S109	360281.621	437816.363	360281.621	437816.363	Required	
S109A	360276.512	437836.396	360276.512	437836.396	Required	
S110	360259.497	437861.557	360259.497	437861.557	Required	
S27	360255.818	437869.342	360255.818	437869.342	Required	
S28	360249.600	437872.305	360249.600	437872.305	Required	
S29	360226.735	437892.369	360226.735	437892.369	Required	
S30	360223.678	437899.685	360223.678	437899.685	Required	
S31	360237.326	437913.745	360237.326	437913.745	Required	
S32	360244.782	437923.780	360244.782	437923.780	Required	
S33	360245.485	437933.033	360245.485	437933.033	Required	
S34	360238.767	437941.908	360238.767	437941.908	Required	
S35	360224.192	437955.546	360224.192	437955.546	Required	
S46	360322.713	437931.499	360322.713	437931.499	Required	
S47	360295.411	437963.229	360295.411	437963.229	Required	

Manhole Schedules for Surface Network 1

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S48	360270.802	437994.203	360270.802	437994.203	Required	
S201	360276.515	438011.955	360276.515	438011.955	Required	
S49	360257.044	437996.173	360257.044	437996.173	Required	
S36	360217.700	437967.325	360217.700	437967.325	Required	
S37	360201.357	437959.502	360201.357	437959.502	Required	
S38	360176.634	437947.669	360176.634	437947.669	Required	
S39	360162.109	437950.453	360162.109	437950.453	Required	
S50	360135.634	437966.802	360135.634	437966.802	Required	
S40	360156.707	437954.016	360156.707	437954.016	Required	
S41	360168.694	437966.984	360168.694	437966.984	Required	
S42	360226.103	437999.836	360226.103	437999.836	Required	
S43	360266.544	438047.879	360266.544	438047.879	Required	
S44	360268.430	438074.482	360268.430	438074.482	Required	
S45	360239.322	438100.823	360239.322	438100.823	Required	
S12	360212.023	438121.115	360212.023	438121.115	Required	

Manhole Schedules for Surface Network 1

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S13	360176.651	438148.554	360176.651	438148.554	Required	
S14	360175.816	438157.429			No Entry	

STORM SEWER DESIGN

Rainfall Simulation

1:30 year event

Simulation Criteria for Surface Network 1

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.800	Storm Duration (mins)	30
Ratio R	0.281		

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 1
Number of Online Controls 2 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.281
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 18.800 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 30
Climate Change (%) 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S1	120 Winter	30	+0%					103.575
1.001	S2	120 Winter	30	+0%					103.575
2.000	S15	15 Winter	30	+0%					104.964
2.001	S16	15 Winter	30	+0%					104.799
2.002	S17	15 Winter	30	+0%	30/15 Summer				104.605
2.003	S18	15 Winter	30	+0%	30/15 Summer				104.555
1.002	S3	120 Winter	30	+0%					103.575
3.000	S19	15 Winter	30	+0%					104.090
3.001	S20	15 Winter	30	+0%					103.794
1.003	S4	120 Winter	30	+0%					103.575
1.004	S5	120 Winter	30	+0%					103.575
1.005	S6	120 Winter	30	+0%					103.575
1.006	S7	120 Winter	30	+0%					103.575
1.007	S8	120 Winter	30	+0%					103.576
1.008	S9	120 Winter	30	+0%					103.576
4.000	S21	15 Winter	30	+0%					104.308
4.001	S22	120 Winter	30	+0%					103.576
1.009	S10	120 Winter	30	+0%					103.576
1.010	S11	120 Winter	30	+0%					103.575
5.000	S23	15 Winter	30	+0%					108.226

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1	-0.631	0.000	0.01			17.8	OK	
1.001	S2	-0.544	0.000	0.02			19.6	OK	
2.000	S15	-0.126	0.000	0.39			14.2	OK	
2.001	S16	-0.138	0.000	0.31			18.8	OK	
2.002	S17	0.097	0.000	0.97			31.9	SURCHARGED	
2.003	S18	0.104	0.000	1.14			60.1	SURCHARGED	
1.002	S3	-0.516	0.000	0.04			44.1	OK	
3.000	S19	-0.187	0.000	0.30			21.3	OK	
3.001	S20	-0.302	0.000	0.23			23.8	OK	
1.003	S4	-0.490	0.000	0.03			51.3	OK	
1.004	S5	-0.448	0.000	0.03			49.5	OK	
1.005	S6	-0.409	0.000	0.04			44.2	OK	
1.006	S7	-0.386	0.000	0.02			40.5	OK	
1.007	S8	-0.342	0.000	0.04			39.5	OK	
1.008	S9	-0.320	0.000	0.02			43.8	OK	
4.000	S21	-0.159	0.000	0.19			12.3	OK	
4.001	S22	-0.294	0.000	0.07			13.8	OK	
1.009	S10	-0.226	0.000	0.02			38.7	OK	
1.010	S11	-0.147	0.000	0.02			29.1	OK	
5.000	S23	-0.171	0.000	0.13			9.3	OK	

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
5.001	S24	15 Winter	30	+0%					107.604
5.002	S25	15 Winter	30	+0%					106.931
5.003	S26	15 Winter	30	+0%					106.746
6.000	S105	15 Winter	30	+0%					111.218
6.001	S106	15 Winter	30	+0%					109.745
7.000	S101	15 Winter	30	+0%					108.660
8.000	S102	15 Winter	30	+0%					110.737
7.001	S103	15 Winter	30	+0%					108.327
7.002	S104	15 Winter	30	+0%					107.528
6.002	S107	15 Winter	30	+0%					107.367
6.003	S108	15 Winter	30	+0%					107.261
6.004	S109	15 Winter	30	+0%					107.250
6.005	S109A	15 Winter	30	+0%					107.239
6.006	S110	15 Winter	30	+0%	30/15 Summer				107.227
5.004	S27	15 Winter	30	+0%					106.539
5.005	S28	15 Winter	30	+0%					106.414
5.006	S29	15 Winter	30	+0%					106.180
5.007	S30	15 Winter	30	+0%					105.998
5.008	S31	15 Winter	30	+0%					105.699
5.009	S32	15 Winter	30	+0%	30/15 Summer				105.659
5.010	S33	15 Winter	30	+0%	30/15 Winter				105.616
5.011	S34	15 Winter	30	+0%					105.421
5.012	S35	15 Winter	30	+0%					105.282
9.000	S46	15 Winter	30	+0%					108.511
9.001	S47	15 Winter	30	+0%					107.324
9.002	S48	15 Winter	30	+0%					105.973
10.000	S201	15 Summer	30	+0%					105.375
9.003	S49	15 Winter	30	+0%					105.375
5.013	S36	30 Winter	30	+0%	30/15 Summer				105.032
5.014	S37	30 Winter	30	+0%	30/15 Summer				104.904
5.015	S38	30 Winter	30	+0%	30/15 Summer				104.743
5.016	S39	30 Winter	30	+0%	30/15 Summer				104.587
11.000	S50	15 Winter	30	+0%					104.462
5.017	S40	30 Winter	30	+0%	30/15 Summer				104.435
5.018	S41	30 Winter	30	+0%	30/30 Winter				104.282
5.019	S42	30 Winter	30	+0%	30/30 Winter				104.100
5.020	S43	120 Winter	30	+0%					103.581
5.021	S44	120 Winter	30	+0%					103.580
5.022	S45	120 Winter	30	+0%					103.578
1.011	S12	120 Winter	30	+0%					103.575
1.012	S13	120 Winter	30	+0%	30/15 Summer				103.568

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
5.001	S24	-0.130	0.000	0.37			29.8	OK	
5.002	S25	-0.115	0.000	0.47			29.7	OK	

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
5.003	S26	-0.103	0.000	0.56			29.5	OK	
6.000	S105	-0.166	0.000	0.15			15.3	OK	
6.001	S106	-0.128	0.000	0.38			35.8	OK	
7.000	S101	-0.115	0.000	0.47			23.1	OK	
8.000	S102	-0.138	0.000	0.32			34.3	OK	
7.001	S103	-0.054	0.000	1.00			83.4	OK	
7.002	S104	-0.549	0.000	0.16			109.9	OK	
6.002	S107	-0.515	0.000	0.21			149.0	OK	
6.003	S108	-0.421	0.000	0.22			168.7	OK	
6.004	S109	-0.186	0.000	0.31			139.9	OK	
6.005	S109A	-0.141	0.000	0.12			112.1	OK	
6.006	S110	0.482	0.000	0.69			94.8	SURCHARGED	
5.004	S27	-0.171	0.000	0.70			118.3	OK	
5.005	S28	-0.243	0.000	0.43			122.3	OK	
5.006	S29	-0.160	0.000	0.74			125.6	OK	
5.007	S30	-0.251	0.000	0.40			131.5	OK	
5.008	S31	-0.212	0.000	0.45			131.5	OK	
5.009	S32	0.020	0.000	1.56			147.3	SURCHARGED	
5.010	S33	0.000	0.000	1.47			146.9	SURCHARGED	
5.011	S34	-0.167	0.000	0.71			148.8	OK	
5.012	S35	-0.167	0.000	0.71			157.5	OK	
9.000	S46	-0.162	0.000	0.17			14.6	OK	
9.001	S47	-0.118	0.000	0.45			41.5	OK	
9.002	S48	-0.105	0.000	0.55			52.2	OK	
10.000	S201	-0.375	0.000	0.00			0.0	OK	
9.003	S49	-0.240	0.000	0.27			77.8	OK	
5.013	S36	0.566	0.000	1.69			204.6	SURCHARGED	
5.014	S37	0.483	0.000	1.53			209.9	SURCHARGED	
5.015	S38	0.391	0.000	2.09			221.8	SURCHARGED	
5.016	S39	0.272	0.000	2.11			223.1	SURCHARGED	
11.000	S50	-0.162	0.000	0.17			9.5	OK	
5.017	S40	0.137	0.000	1.93			229.9	SURCHARGED	
5.018	S41	0.028	0.000	1.07			235.1	SURCHARGED	
5.019	S42	0.011	0.000	1.11			243.2	SURCHARGED	
5.020	S43	-0.351	0.000	0.07			168.6	OK	
5.021	S44	-0.285	0.000	0.06			152.7	OK	
5.022	S45	-0.189	0.000	0.06			135.0	OK	
1.011	S12	-0.107	0.000	0.03			78.5	OK	
1.012	S13	1.175	0.000	0.81			49.8	SURCHARGED	

STORM SEWER DESIGN

Rainfall Simulation

1:30 year event with Surcharged Outfall

Surcharged Outfall Details for Surface Network 1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.012	S14	102.473	102.040	0.000	600	0

Datum (m) 102.040 Offset (mins) 0

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
1	0.520	42	0.520	83	0.520	124	0.520	165	0.520	206	0.520
2	0.520	43	0.520	84	0.520	125	0.520	166	0.520	207	0.520
3	0.520	44	0.520	85	0.520	126	0.520	167	0.520	208	0.520
4	0.520	45	0.520	86	0.520	127	0.520	168	0.520	209	0.520
5	0.520	46	0.520	87	0.520	128	0.520	169	0.520	210	0.520
6	0.520	47	0.520	88	0.520	129	0.520	170	0.520	211	0.520
7	0.520	48	0.520	89	0.520	130	0.520	171	0.520	212	0.520
8	0.520	49	0.520	90	0.520	131	0.520	172	0.520	213	0.520
9	0.520	50	0.520	91	0.520	132	0.520	173	0.520	214	0.520
10	0.520	51	0.520	92	0.520	133	0.520	174	0.520	215	0.520
11	0.520	52	0.520	93	0.520	134	0.520	175	0.520	216	0.520
12	0.520	53	0.520	94	0.520	135	0.520	176	0.520	217	0.520
13	0.520	54	0.520	95	0.520	136	0.520	177	0.520	218	0.520
14	0.520	55	0.520	96	0.520	137	0.520	178	0.520	219	0.520
15	0.520	56	0.520	97	0.520	138	0.520	179	0.520	220	0.520
16	0.520	57	0.520	98	0.520	139	0.520	180	0.520	221	0.520
17	0.520	58	0.520	99	0.520	140	0.520	181	0.520	222	0.520
18	0.520	59	0.520	100	0.520	141	0.520	182	0.520	223	0.520
19	0.520	60	0.520	101	0.520	142	0.520	183	0.520	224	0.520
20	0.520	61	0.520	102	0.520	143	0.520	184	0.520	225	0.520
21	0.520	62	0.520	103	0.520	144	0.520	185	0.520	226	0.520
22	0.520	63	0.520	104	0.520	145	0.520	186	0.520	227	0.520
23	0.520	64	0.520	105	0.520	146	0.520	187	0.520	228	0.520
24	0.520	65	0.520	106	0.520	147	0.520	188	0.520	229	0.520
25	0.520	66	0.520	107	0.520	148	0.520	189	0.520	230	0.520
26	0.520	67	0.520	108	0.520	149	0.520	190	0.520	231	0.520
27	0.520	68	0.520	109	0.520	150	0.520	191	0.520	232	0.520
28	0.520	69	0.520	110	0.520	151	0.520	192	0.520	233	0.520
29	0.520	70	0.520	111	0.520	152	0.520	193	0.520	234	0.520
30	0.520	71	0.520	112	0.520	153	0.520	194	0.520	235	0.520
31	0.520	72	0.520	113	0.520	154	0.520	195	0.520	236	0.520
32	0.520	73	0.520	114	0.520	155	0.520	196	0.520	237	0.520
33	0.520	74	0.520	115	0.520	156	0.520	197	0.520	238	0.520
34	0.520	75	0.520	116	0.520	157	0.520	198	0.520	239	0.520
35	0.520	76	0.520	117	0.520	158	0.520	199	0.520	240	0.520
36	0.520	77	0.520	118	0.520	159	0.520	200	0.520	241	0.520
37	0.520	78	0.520	119	0.520	160	0.520	201	0.520	242	0.520
38	0.520	79	0.520	120	0.520	161	0.520	202	0.520	243	0.520
39	0.520	80	0.520	121	0.520	162	0.520	203	0.520	244	0.520
40	0.520	81	0.520	122	0.520	163	0.520	204	0.520	245	0.520
41	0.520	82	0.520	123	0.520	164	0.520	205	0.520	246	0.520

Surcharged Outfall Details for Surface Network 1

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
247	0.520	266	0.520	285	0.520	304	0.520	323	0.520	342	0.520
248	0.520	267	0.520	286	0.520	305	0.520	324	0.520	343	0.520
249	0.520	268	0.520	287	0.520	306	0.520	325	0.520	344	0.520
250	0.520	269	0.520	288	0.520	307	0.520	326	0.520	345	0.520
251	0.520	270	0.520	289	0.520	308	0.520	327	0.520	346	0.520
252	0.520	271	0.520	290	0.520	309	0.520	328	0.520	347	0.520
253	0.520	272	0.520	291	0.520	310	0.520	329	0.520	348	0.520
254	0.520	273	0.520	292	0.520	311	0.520	330	0.520	349	0.520
255	0.520	274	0.520	293	0.520	312	0.520	331	0.520	350	0.520
256	0.520	275	0.520	294	0.520	313	0.520	332	0.520	351	0.520
257	0.520	276	0.520	295	0.520	314	0.520	333	0.520	352	0.520
258	0.520	277	0.520	296	0.520	315	0.520	334	0.520	353	0.520
259	0.520	278	0.520	297	0.520	316	0.520	335	0.520	354	0.520
260	0.520	279	0.520	298	0.520	317	0.520	336	0.520	355	0.520
261	0.520	280	0.520	299	0.520	318	0.520	337	0.520	356	0.520
262	0.520	281	0.520	300	0.520	319	0.520	338	0.520	357	0.520
263	0.520	282	0.520	301	0.520	320	0.520	339	0.520	358	0.520
264	0.520	283	0.520	302	0.520	321	0.520	340	0.520	359	0.520
265	0.520	284	0.520	303	0.520	322	0.520	341	0.520	360	0.520

Simulation Criteria for Surface Network 1

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.800	Storm Duration (mins)	30
Ratio R	0.281		

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 1
Number of Online Controls 2 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.281
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 18.800 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 30
Climate Change (%) 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S1	240 Winter	30	+0%					103.687
1.001	S2	240 Winter	30	+0%					103.687
2.000	S15	15 Winter	30	+0%					104.964
2.001	S16	15 Winter	30	+0%					104.799
2.002	S17	15 Winter	30	+0%	30/15 Summer				104.605
2.003	S18	15 Winter	30	+0%	30/15 Summer				104.555
1.002	S3	240 Winter	30	+0%					103.687
3.000	S19	15 Winter	30	+0%					104.090
3.001	S20	15 Winter	30	+0%					103.794
1.003	S4	240 Winter	30	+0%					103.687
1.004	S5	240 Winter	30	+0%					103.687
1.005	S6	240 Winter	30	+0%					103.687
1.006	S7	240 Winter	30	+0%					103.687
1.007	S8	240 Winter	30	+0%					103.687
1.008	S9	240 Winter	30	+0%					103.687
4.000	S21	15 Winter	30	+0%					104.308
4.001	S22	240 Winter	30	+0%					103.687
1.009	S10	240 Winter	30	+0%					103.686
1.010	S11	240 Winter	30	+0%					103.684
5.000	S23	15 Winter	30	+0%					108.226

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1	-0.519	0.000	0.01			10.2	OK	
1.001	S2	-0.432	0.000	0.01			10.2	OK	
2.000	S15	-0.126	0.000	0.39			14.2	OK	
2.001	S16	-0.138	0.000	0.31			18.8	OK	
2.002	S17	0.097	0.000	0.97			31.9	SURCHARGED	
2.003	S18	0.104	0.000	1.14			60.1	SURCHARGED	
1.002	S3	-0.404	0.000	0.02			23.1	OK	
3.000	S19	-0.187	0.000	0.30			21.3	OK	
3.001	S20	-0.302	0.000	0.23			23.8	OK	
1.003	S4	-0.378	0.000	0.02			26.6	OK	
1.004	S5	-0.336	0.000	0.02			24.4	OK	
1.005	S6	-0.297	0.000	0.02			19.7	OK	
1.006	S7	-0.274	0.000	0.01			17.1	OK	
1.007	S8	-0.231	0.000	0.02			17.4	OK	
1.008	S9	-0.209	0.000	0.01			18.9	OK	
4.000	S21	-0.159	0.000	0.19			12.3	OK	
4.001	S22	-0.183	0.000	0.04			8.7	OK	
1.009	S10	-0.116	0.000	0.01			25.8	OK	
1.010	S11	-0.038	0.000	0.02			30.7	OK	
5.000	S23	-0.171	0.000	0.13			9.3	OK	

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
5.001	S24	15 Winter	30	+0%					107.604
5.002	S25	15 Winter	30	+0%					106.931
5.003	S26	15 Winter	30	+0%					106.746
6.000	S105	15 Winter	30	+0%					111.218
6.001	S106	15 Winter	30	+0%					109.745
7.000	S101	15 Winter	30	+0%					108.660
8.000	S102	15 Winter	30	+0%					110.737
7.001	S103	15 Winter	30	+0%					108.327
7.002	S104	15 Winter	30	+0%					107.528
6.002	S107	15 Winter	30	+0%					107.367
6.003	S108	15 Winter	30	+0%					107.261
6.004	S109	15 Winter	30	+0%					107.250
6.005	S109A	15 Winter	30	+0%					107.239
6.006	S110	15 Winter	30	+0%	30/15 Summer				107.227
5.004	S27	15 Winter	30	+0%					106.539
5.005	S28	15 Winter	30	+0%					106.414
5.006	S29	15 Winter	30	+0%					106.180
5.007	S30	15 Winter	30	+0%					105.998
5.008	S31	15 Winter	30	+0%					105.699
5.009	S32	15 Winter	30	+0%	30/15 Summer				105.659
5.010	S33	15 Winter	30	+0%	30/15 Winter				105.616
5.011	S34	15 Winter	30	+0%					105.421
5.012	S35	15 Winter	30	+0%					105.282
9.000	S46	15 Winter	30	+0%					108.511
9.001	S47	15 Winter	30	+0%					107.324
9.002	S48	15 Winter	30	+0%					105.973
10.000	S201	15 Summer	30	+0%					105.375
9.003	S49	15 Winter	30	+0%					105.375
5.013	S36	30 Winter	30	+0%	30/15 Summer				105.032
5.014	S37	30 Winter	30	+0%	30/15 Summer				104.904
5.015	S38	30 Winter	30	+0%	30/15 Summer				104.743
5.016	S39	30 Winter	30	+0%	30/15 Summer				104.587
11.000	S50	15 Winter	30	+0%					104.462
5.017	S40	30 Winter	30	+0%	30/15 Summer				104.435
5.018	S41	30 Winter	30	+0%	30/30 Winter				104.282
5.019	S42	30 Winter	30	+0%	30/30 Winter				104.100
5.020	S43	240 Winter	30	+0%					103.704
5.021	S44	240 Winter	30	+0%					103.701
5.022	S45	240 Winter	30	+0%					103.694
1.011	S12	180 Winter	30	+0%					103.682
1.012	S13	180 Winter	30	+0%	30/15 Summer				103.659

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
5.001	S24	-0.130	0.000	0.37			29.8	OK	
5.002	S25	-0.115	0.000	0.47			29.7	OK	

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
5.003	S26	-0.103	0.000	0.56			29.5	OK	
6.000	S105	-0.166	0.000	0.15			15.3	OK	
6.001	S106	-0.128	0.000	0.38			35.8	OK	
7.000	S101	-0.115	0.000	0.47			23.1	OK	
8.000	S102	-0.138	0.000	0.32			34.3	OK	
7.001	S103	-0.054	0.000	1.00			83.4	OK	
7.002	S104	-0.549	0.000	0.16			109.9	OK	
6.002	S107	-0.515	0.000	0.21			149.0	OK	
6.003	S108	-0.421	0.000	0.22			168.7	OK	
6.004	S109	-0.186	0.000	0.31			139.9	OK	
6.005	S109A	-0.141	0.000	0.12			112.1	OK	
6.006	S110	0.482	0.000	0.69			94.8	SURCHARGED	
5.004	S27	-0.171	0.000	0.70			118.3	OK	
5.005	S28	-0.243	0.000	0.43			122.3	OK	
5.006	S29	-0.160	0.000	0.74			125.6	OK	
5.007	S30	-0.251	0.000	0.40			131.5	OK	
5.008	S31	-0.212	0.000	0.45			131.5	OK	
5.009	S32	0.020	0.000	1.56			147.3	SURCHARGED	
5.010	S33	0.000	0.000	1.47			146.9	SURCHARGED	
5.011	S34	-0.167	0.000	0.71			148.8	OK	
5.012	S35	-0.167	0.000	0.71			157.5	OK	
9.000	S46	-0.162	0.000	0.17			14.6	OK	
9.001	S47	-0.118	0.000	0.45			41.5	OK	
9.002	S48	-0.105	0.000	0.55			52.2	OK	
10.000	S201	-0.375	0.000	0.00			0.0	OK	
9.003	S49	-0.240	0.000	0.27			77.8	OK	
5.013	S36	0.566	0.000	1.69			204.6	SURCHARGED	
5.014	S37	0.483	0.000	1.53			209.9	SURCHARGED	
5.015	S38	0.391	0.000	2.09			221.8	SURCHARGED	
5.016	S39	0.272	0.000	2.11			223.1	SURCHARGED	
11.000	S50	-0.162	0.000	0.17			9.5	OK	
5.017	S40	0.137	0.000	1.93			229.9	SURCHARGED	
5.018	S41	0.028	0.000	1.07			235.1	SURCHARGED	
5.019	S42	0.011	0.000	1.11			243.2	SURCHARGED	
5.020	S43	-0.228	0.000	0.05			114.6	OK	
5.021	S44	-0.164	0.000	0.04			105.0	OK	
5.022	S45	-0.073	0.000	0.04			96.1	OK	
1.011	S12	0.000	0.000	0.03			69.3	OK	
1.012	S13	1.266	0.000	0.81			49.9	SURCHARGED	

STORM SEWER DESIGN

Rainfall Simulation

1:100 year event +30% Climate Change

Simulation Criteria for Surface Network 1

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.800	Storm Duration (mins)	30
Ratio R	0.281		

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 1
Number of Online Controls 2 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.281
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 18.800 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 100
Climate Change (%) 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S1	240 Winter	100	+30%					104.072
1.001	S2	240 Winter	100	+30%					104.072
2.000	S15	15 Winter	100	+30%	100/15 Summer				105.304
2.001	S16	15 Winter	100	+30%	100/15 Summer				105.258
2.002	S17	15 Winter	100	+30%	100/15 Summer				105.189
2.003	S18	15 Winter	100	+30%	100/15 Summer				105.093
1.002	S3	240 Winter	100	+30%					104.071
3.000	S19	15 Winter	100	+30%					104.129
3.001	S20	240 Winter	100	+30%					104.071
1.003	S4	240 Winter	100	+30%	100/180 Winter				104.071
1.004	S5	240 Winter	100	+30%	100/120 Winter				104.072
1.005	S6	240 Winter	100	+30%	100/120 Winter				104.072
1.006	S7	240 Winter	100	+30%	100/120 Winter				104.072
1.007	S8	240 Winter	100	+30%	100/120 Winter				104.072
1.008	S9	240 Winter	100	+30%	100/120 Summer				104.072
4.000	S21	15 Winter	100	+30%					104.329
4.001	S22	240 Winter	100	+30%	100/60 Winter				104.072
1.009	S10	240 Winter	100	+30%	100/60 Summer				104.072
1.010	S11	240 Winter	100	+30%	100/30 Winter				104.072
5.000	S23	15 Winter	100	+30%					108.244

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1	-0.134	0.000	0.01			16.8	OK	
1.001	S2	-0.047	0.000	0.01			14.9	OK	
2.000	S15	0.214	0.000	0.57			20.8	SURCHARGED	
2.001	S16	0.321	0.000	0.50			30.7	SURCHARGED	
2.002	S17	0.681	0.000	1.39			45.7	SURCHARGED	
2.003	S18	0.642	0.000	1.65			87.3	SURCHARGED	
1.002	S3	-0.020	0.000	0.03			37.5	OK	
3.000	S19	-0.148	0.000	0.50			35.1	OK	
3.001	S20	-0.025	0.000	0.10			9.7	OK	
1.003	S4	0.006	0.000	0.03			46.3	SURCHARGED	
1.004	S5	0.049	0.000	0.03			47.1	SURCHARGED	
1.005	S6	0.088	0.000	0.04			42.6	SURCHARGED	
1.006	S7	0.111	0.000	0.02			40.6	SURCHARGED	
1.007	S8	0.154	0.000	0.04			41.7	SURCHARGED	
1.008	S9	0.176	0.000	0.02			48.9	SURCHARGED	
4.000	S21	-0.138	0.000	0.31			20.7	OK	
4.001	S22	0.202	0.000	0.07			14.3	SURCHARGED	
1.009	S10	0.270	0.000	0.02			55.5	SURCHARGED	
1.010	S11	0.350	0.000	0.03			56.7	SURCHARGED	
5.000	S23	-0.153	0.000	0.22			15.6	OK	

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
5.001	S24	15 Winter	100	+30%				
5.002	S25	15 Winter	100	+30%				
5.003	S26	15 Winter	100	+30%				
6.000	S105	15 Winter	100	+30%				
6.001	S106	15 Winter	100	+30%				
7.000	S101	15 Winter	100	+30%	100/15 Summer			
8.000	S102	15 Winter	100	+30%				
7.001	S103	15 Winter	100	+30%	100/15 Summer			
7.002	S104	30 Winter	100	+30%				
6.002	S107	30 Winter	100	+30%	100/30 Winter			
6.003	S108	30 Winter	100	+30%	100/15 Winter			
6.004	S109	30 Winter	100	+30%	100/15 Summer			
6.005	S109A	30 Winter	100	+30%	100/15 Summer			
6.006	S110	30 Winter	100	+30%	100/15 Summer			
5.004	S27	30 Winter	100	+30%	100/30 Winter			
5.005	S28	30 Winter	100	+30%	100/30 Winter			
5.006	S29	30 Winter	100	+30%	100/15 Winter			
5.007	S30	30 Winter	100	+30%	100/15 Winter			
5.008	S31	30 Winter	100	+30%	100/15 Summer			
5.009	S32	30 Winter	100	+30%	100/15 Summer			
5.010	S33	30 Winter	100	+30%	100/15 Summer			
5.011	S34	30 Winter	100	+30%	100/15 Summer			
5.012	S35	30 Winter	100	+30%	100/15 Summer			
9.000	S46	15 Winter	100	+30%				
9.001	S47	15 Winter	100	+30%				
9.002	S48	30 Winter	100	+30%	100/30 Winter			
10.000	S201	30 Winter	100	+30%	100/15 Winter			
9.003	S49	30 Winter	100	+30%	100/15 Winter			
5.013	S36	30 Winter	100	+30%	100/15 Summer			
5.014	S37	30 Winter	100	+30%	100/15 Summer			
5.015	S38	30 Winter	100	+30%	100/15 Summer			
5.016	S39	30 Winter	100	+30%	100/15 Summer			
11.000	S50	30 Winter	100	+30%	100/15 Summer			
5.017	S40	30 Winter	100	+30%	100/15 Summer			
5.018	S41	30 Winter	100	+30%	100/15 Summer			
5.019	S42	30 Winter	100	+30%	100/15 Summer			
5.020	S43	240 Winter	100	+30%	100/120 Winter			
5.021	S44	240 Winter	100	+30%	100/60 Winter			
5.022	S45	240 Winter	100	+30%	100/60 Summer			
1.011	S12	240 Winter	100	+30%	100/30 Winter			
1.012	S13	240 Winter	100	+30%	100/15 Summer			

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
5.001	S24	107.639	-0.095	0.000	0.62			50.0	OK
5.002	S25	106.975	-0.071	0.000	0.79			49.8	OK

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
5.003	S26	106.798	-0.051	0.000	0.94			49.4	OK
6.000	S105	111.237	-0.147	0.000	0.26			25.7	OK
6.001	S106	109.780	-0.093	0.000	0.64			60.0	OK
7.000	S101	109.009	0.234	0.000	0.75			36.8	SURCHARGED
8.000	S102	110.768	-0.107	0.000	0.53			57.6	OK
7.001	S103	108.787	0.406	0.000	1.53			128.1	SURCHARGED
7.002	S104	107.942	-0.135	0.000	0.21			146.3	OK
6.002	S107	107.932	0.050	0.000	0.26			183.6	SURCHARGED
6.003	S108	107.917	0.235	0.000	0.24			185.8	SURCHARGED
6.004	S109	107.899	0.463	0.000	0.32			143.9	SURCHARGED
6.005	S109A	107.884	0.504	0.000	0.15			135.5	SURCHARGED
6.006	S110	107.867	1.122	0.000	0.97			133.5	SURCHARGED
5.004	S27	106.755	0.045	0.000	1.00			168.8	SURCHARGED
5.005	S28	106.712	0.055	0.000	0.61			172.5	SURCHARGED
5.006	S29	106.605	0.265	0.000	1.01			170.9	SURCHARGED
5.007	S30	106.555	0.306	0.000	0.54			177.5	SURCHARGED
5.008	S31	106.461	0.550	0.000	0.61			180.3	SURCHARGED
5.009	S32	106.393	0.754	0.000	2.02			190.8	SURCHARGED
5.010	S33	106.284	0.668	0.000	1.93			193.0	SURCHARGED
5.011	S34	106.176	0.588	0.000	0.94			196.7	SURCHARGED
5.012	S35	106.064	0.615	0.000	0.92			204.7	SURCHARGED
9.000	S46	108.531	-0.142	0.000	0.29			24.5	OK
9.001	S47	107.366	-0.076	0.000	0.76			69.6	OK
9.002	S48	106.161	0.083	0.000	0.75			71.3	SURCHARGED
10.000	S201	106.003	0.253	0.000	0.04			5.0	SURCHARGED
9.003	S49	106.006	0.391	0.000	0.34			96.5	SURCHARGED
5.013	S36	105.942	1.476	0.000	2.17			262.2	SURCHARGED
5.014	S37	105.725	1.304	0.000	1.98			271.0	SURCHARGED
5.015	S38	105.457	1.105	0.000	2.71			288.5	SURCHARGED
5.016	S39	105.194	0.879	0.000	2.75			291.1	SURCHARGED
11.000	S50	104.949	0.325	0.000	0.22			12.0	SURCHARGED
5.017	S40	104.929	0.631	0.000	2.54			302.4	SURCHARGED
5.018	S41	104.645	0.391	0.000	1.45			318.9	SURCHARGED
5.019	S42	104.294	0.205	0.000	1.56			342.6	SURCHARGED
5.020	S43	104.074	0.142	0.000	0.08			190.8	SURCHARGED
5.021	S44	104.073	0.208	0.000	0.07			185.9	SURCHARGED
5.022	S45	104.073	0.306	0.000	0.08			186.8	SURCHARGED
1.011	S12	104.072	0.390	0.000	0.10			228.5	SURCHARGED
1.012	S13	104.071	1.678	0.000	0.81			49.9	SURCHARGED

PN	US/MH Name	Level Exceeded
5.001	S24	
5.002	S25	
5.003	S26	
6.000	S105	

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Level Exceeded
6.001	S106	
7.000	S101	
8.000	S102	
7.001	S103	
7.002	S104	
6.002	S107	
6.003	S108	
6.004	S109	
6.005	S109A	
6.006	S110	
5.004	S27	
5.005	S28	
5.006	S29	
5.007	S30	
5.008	S31	
5.009	S32	
5.010	S33	
5.011	S34	
5.012	S35	
9.000	S46	
9.001	S47	
9.002	S48	
10.000	S201	
9.003	S49	
5.013	S36	
5.014	S37	
5.015	S38	
5.016	S39	
11.000	S50	
5.017	S40	
5.018	S41	
5.019	S42	
5.020	S43	
5.021	S44	
5.022	S45	
1.011	S12	
1.012	S13	

Storm Water Network 3

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Surface Network 3

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	18.800	Add Flow / Climate Change (%)	0
Ratio R	0.281	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Surface Network 3

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	18.574	0.113	164.4	0.129	5.00	0.0	0.600	o	225	Pipe/Conduit	🔒
1.001	21.020	0.127	165.5	0.023	0.00	0.0	0.600	o	225	Pipe/Conduit	🔓
1.002	38.591	0.234	164.9	0.082	0.00	0.0	0.600	o	300	Pipe/Conduit	🔓
2.000	20.496	0.637	32.2	0.052	5.00	0.0	0.600	o	225	Pipe/Conduit	🔒
2.001	20.288	0.630	32.2	0.047	0.00	0.0	0.600	o	225	Pipe/Conduit	🔓
2.002	33.160	1.079	30.7	0.028	0.00	0.0	0.600	o	225	Pipe/Conduit	🔓
1.003	32.000	0.905	35.4	0.084	0.00	0.0	0.600	o	300	Pipe/Conduit	🔓
1.004	18.105	0.540	33.5	0.031	0.00	0.0	0.600	o	300	Pipe/Conduit	🔓
1.005	21.220	0.633	33.5	0.055	0.00	0.0	0.600	o	300	Pipe/Conduit	🔓

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.30	113.750	0.129	0.0	0.0	0.0	1.02	40.4	17.5
1.001	50.00	5.65	113.637	0.152	0.0	0.0	0.0	1.01	40.3	20.6
1.002	50.00	6.18	113.435	0.234	0.0	0.0	0.0	1.22	86.3	31.7
2.000	50.00	5.15	115.622	0.052	0.0	0.0	0.0	2.31	92.0	7.0
2.001	50.00	5.29	114.985	0.099	0.0	0.0	0.0	2.31	92.0	13.4
2.002	50.00	5.53	114.355	0.127	0.0	0.0	0.0	2.37	94.2	17.2
1.003	50.00	6.38	113.201	0.445	0.0	0.0	0.0	2.65	187.5	60.3
1.004	49.71	6.49	112.296	0.476	0.0	0.0	0.0	2.72	192.6	64.1
1.005	49.30	6.62	111.756	0.531	0.0	0.0	0.0	2.72	192.6	70.9

Network Design Table for Surface Network 3

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.006	26.149	0.972	26.9	0.030	0.00	0.0	0.600	o	300	Pipe/Conduit	🔓
1.007	14.101	0.463	30.5	0.032	0.00	0.0	0.600	o	450	Pipe/Conduit	🔓
3.000	66.749	1.420	47.0	0.081	5.00	0.0	0.600	o	225	Pipe/Conduit	🔒
1.008	11.314	0.343	33.0	0.089	0.00	0.0	0.600	o	450	Pipe/Conduit	🔓
1.009	75.598	2.291	33.0	0.107	0.00	0.0	0.600	o	450	Pipe/Conduit	🔒
1.010	19.351	0.586	33.0	0.150	0.00	0.0	0.600	o	450	Pipe/Conduit	🔒
4.000	20.774	0.472	44.0	0.094	5.00	0.0	0.600	o	150	Pipe/Conduit	🔒
4.001	31.984	0.727	44.0	0.024	0.00	0.0	0.600	o	150	Pipe/Conduit	🔒
4.002	15.379	0.349	44.1	0.087	0.00	0.0	0.600	o	150	Pipe/Conduit	🔒
1.011	9.311	0.023	404.8	0.000	0.00	0.0	0.600	o	1500	Pipe/Conduit	🔓
5.000	33.973	0.085	399.7	0.120	5.00	0.0	0.600	o	1500	Pipe/Conduit	🔒
5.001	19.633	0.049	400.7	0.096	0.00	0.0	0.600	o	1500	Pipe/Conduit	🔓
1.012	62.392	0.156	399.9	0.058	0.00	0.0	0.600	o	1500	Pipe/Conduit	🔓
1.013	17.480	0.044	397.3	0.054	0.00	0.0	0.600	o	1500	Pipe/Conduit	🔓
1.014	12.998	0.078	166.6	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.006	48.86	6.76	111.123	0.561	0.0	0.0	0.0	3.04	215.1	74.2
1.007	48.67	6.82	110.001	0.593	0.0	0.0	0.0	3.69	587.6	78.2
3.000	50.00	5.58	112.437	0.081	0.0	0.0	0.0	1.91	76.1	11.0
1.008	48.51	6.88	109.538	0.763	0.0	0.0	0.0	3.55	564.5	100.2
1.009	47.48	7.23	109.194	0.870	0.0	0.0	0.0	3.55	564.4	111.9
1.010	47.23	7.32	105.438	1.020	0.0	0.0	0.0	3.55	564.2	130.5
4.000	50.00	5.23	109.677	0.094	0.0	0.0	0.0	1.52	26.9	12.7
4.001	50.00	5.58	107.728	0.118	0.0	0.0	0.0	1.52	26.9	16.0
4.002	50.00	5.75	105.501	0.205	0.0	0.0	0.0	1.52	26.9«	27.8
1.011	47.02	7.40	103.802	1.225	0.0	0.0	0.0	2.13	3756.4	156.0
5.000	50.00	5.26	103.912	0.120	0.0	0.0	0.0	2.14	3780.6	16.2
5.001	50.00	5.42	103.827	0.216	0.0	0.0	0.0	2.14	3775.9	29.2
1.012	45.73	7.88	103.778	1.499	0.0	0.0	0.0	2.14	3779.3	185.7
1.013	45.39	8.02	103.622	1.553	0.0	0.0	0.0	2.15	3792.1	190.9
1.014	44.85	8.23	103.578	1.553	0.0	0.0	0.0	1.01	40.2«	190.9

Online Controls for Surface Network 3

Depth/Flow Relationship Manhole: S324, DS/PN: 1.014, Volume (m^3): 48.8

Invert Level (m) 103.578

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	7.9700	0.800	34.6400	2.000	33.5200	3.800	46.2000
0.200	17.9600	1.000	32.1700	2.200	35.1600	4.200	48.5800
0.300	26.1200	1.200	30.5300	2.400	36.7200	4.600	50.8400
0.400	31.6700	1.400	29.7200	2.600	38.2200	5.000	53.0000
0.500	34.7400	1.600	29.9800	3.000	41.0500		
0.600	35.8600	1.800	31.8000	3.400	43.7000		

Storage Structures for Surface Network 3

Tank or Pond Manhole: S324, DS/PN: 1.014

Invert Level (m) 106.350

Depth (m)	**Area (m²)**	**Depth (m)**	**Area (m²)**
0.000	451.4	0.800	1004.1

Manhole Schedules for Surface Network 3

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
S301	116.010	2.260	Open Manhole	1800	1.000	113.750	225				
S302	115.684	2.047	Open Manhole	1800	1.001	113.637	225	1.000	113.637	225	
S303	115.415	1.980	Open Manhole	1800	1.002	113.435	300	1.001	113.510	225	
S304	117.197	1.575	Open Manhole	1350	2.000	115.622	225				
S305	116.721	1.736	Open Manhole	1350	2.001	114.985	225	2.000	114.985	225	
S306	116.084	1.729	Open Manhole	1350	2.002	114.355	225	2.001	114.355	225	
S307	115.067	1.866	Open Manhole	1800	1.003	113.201	300	1.002	113.201	300	
								2.002	113.276	225	
S308	114.042	1.746	Open Manhole	1350	1.004	112.296	300	1.003	112.296	300	
S309	113.576	1.820	Open Manhole	1350	1.005	111.756	300	1.004	111.756	300	
S310	113.216	2.093	Open Manhole	1350	1.006	111.123	300	1.005	111.123	300	
S311	113.012	3.011	Open Manhole	1500	1.007	110.001	450	1.006	110.151	300	
S312	114.027	1.590	Open Manhole	1500	3.000	112.437	225				
S313	113.198	3.660	Open Manhole	1800	1.008	109.538	450	1.007	109.538	450	
								3.000	111.017	225	1254
S314	112.916	3.722	Open Manhole	1800	1.009	109.194	450	1.008	109.195	450	1
S315	111.041	5.603	Open Manhole	1800	1.010	105.438	450	1.009	106.903	450	1465
S316	111.170	1.493	Open Manhole	1350	4.000	109.677	150				
S317	110.773	3.045	Open Manhole	1200	4.001	107.728	150	4.000	109.205	150	1477
S318	110.263	4.762	Open Manhole	1350	4.002	105.501	150	4.001	107.001	150	1500
S319	110.208	6.406	Open Manhole	3000	1.011	103.802	1500	1.010	104.852	450	
								4.002	105.152	150	
S320	109.345	5.433	Open Manhole	3000	5.000	103.912	1500				
S321	109.856	6.029	Open Manhole	3000	5.001	103.827	1500	5.000	103.827	1500	
S322	109.780	6.002	Open Manhole	3000	1.012	103.778	1500	1.011	103.779	1500	1
								5.001	103.778	1500	
S323	107.270	3.648	Open Manhole	3000	1.013	103.622	1500	1.012	103.622	1500	
S324	106.860	3.282	Open Manhole	3000	1.014	103.578	225	1.013	103.578	1500	
S325	103.900	0.400	Open Manhole	0		OUTFALL		1.014	103.500	225	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S301	360511.561	437893.841	360511.561	437893.841	Required	

Manhole Schedules for Surface Network 3

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S302	360496.828	437882.530	360496.828	437882.530	Required	
S303	360484.705	437865.358	360484.705	437865.358	Required	
S304	360540.687	437834.207	360540.687	437834.207	Required	
S305	360524.091	437822.179	360524.091	437822.179	Required	
S306	360503.953	437819.724	360503.953	437819.724	Required	
S307	360472.084	437828.889	360472.084	437828.889	Required	
S308	360441.293	437837.603	360441.293	437837.603	Required	
S309	360429.491	437851.332	360429.491	437851.332	Required	
S310	360424.950	437872.060	360424.950	437872.060	Required	
S311	360414.973	437896.231	360414.973	437896.231	Required	
S312	360465.454	437958.539	360465.454	437958.539	Required	
S313	360426.523	437904.320	360426.523	437904.320	Required	
S314	360420.446	437913.864	360420.446	437913.864	Required	
S315	360379.843	437977.633	360379.843	437977.633	Required	
S316	360422.942	438021.553	360422.942	438021.553	Required	

Manhole Schedules for Surface Network 3

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S317	360402.923	438016.002	360402.923	438016.002	Required	
S318	360374.989	438000.425	360374.989	438000.425	Required	
S319	360364.390	437989.281	360364.390	437989.281	Required	
S320	360314.485	437963.005	360314.485	437963.005	Required	
S321	360343.099	437981.320	360343.099	437981.320	Required	
S322	360357.105	437995.079	360357.105	437995.079	Required	
S323	360316.597	438042.533	360316.597	438042.533	Required	
S324	360305.768	438056.255	360305.768	438056.255	Required	
S325	360295.300	438063.960			No Entry	

STORM SEWER DESIGN

Rainfall Simulation

1:30 year event

Simulation Criteria for Surface Network 3

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.800	Storm Duration (mins)	30
Ratio R	0.281		

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 3

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 1
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.281
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 18.800 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep Fine Inertia Status ON
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 30
Climate Change (%) 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S301	15 Winter	30	+0%	30/15 Winter				113.980
1.001	S302	15 Winter	30	+0%	30/15 Summer				113.878
1.002	S303	15 Winter	30	+0%					113.634
2.000	S304	15 Winter	30	+0%					115.686
2.001	S305	15 Winter	30	+0%					115.077
2.002	S306	15 Winter	30	+0%					114.458
1.003	S307	15 Winter	30	+0%					113.390
1.004	S308	15 Winter	30	+0%					112.499
1.005	S309	15 Winter	30	+0%					111.973
1.006	S310	15 Winter	30	+0%					111.328
1.007	S311	15 Winter	30	+0%					110.205
3.000	S312	15 Winter	30	+0%					112.524
1.008	S313	15 Winter	30	+0%					109.800
1.009	S314	15 Winter	30	+0%					109.405
1.010	S315	15 Winter	30	+0%					105.701
4.000	S316	15 Winter	30	+0%	30/15 Winter				109.837
4.001	S317	15 Winter	30	+0%	30/15 Summer				108.213
4.002	S318	15 Winter	30	+0%	30/15 Summer				106.824
1.011	S319	120 Winter	30	+0%	30/120 Winter				105.336
5.000	S320	120 Winter	30	+0%					105.336

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 3

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S301	0.005	0.000	0.95			34.5	SURCHARGED	
1.001	S302	0.016	0.000	1.08			39.4	SURCHARGED	
1.002	S303	-0.101	0.000	0.76			60.5	OK	
2.000	S304	-0.161	0.000	0.18			14.7	OK	
2.001	S305	-0.133	0.000	0.35			28.9	OK	
2.002	S306	-0.122	0.000	0.42			37.2	OK	
1.003	S307	-0.111	0.000	0.70			119.8	OK	
1.004	S308	-0.097	0.000	0.78			129.0	OK	
1.005	S309	-0.083	0.000	0.86			144.5	OK	
1.006	S310	-0.095	0.000	0.79			152.9	OK	
1.007	S311	-0.246	0.000	0.42			161.4	OK	
3.000	S312	-0.138	0.000	0.31			22.8	OK	
1.008	S313	-0.188	0.000	0.63			208.0	OK	
1.009	S314	-0.239	0.000	0.45			235.6	OK	
1.010	S315	-0.187	0.000	0.64			274.4	OK	
4.000	S316	0.010	0.000	1.01			25.7	SURCHARGED	
4.001	S317	0.335	0.000	1.21			31.2	SURCHARGED	
4.002	S318	1.173	0.000	2.07			51.3	SURCHARGED	
1.011	S319	0.034	0.000	0.10			127.1	SURCHARGED	
5.000	S320	-0.076	0.000	0.00			8.4	OK	

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 3

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
5.001	S321	120 Winter	30	+0%	30/120 Winter				105.335
1.012	S322	120 Winter	30	+0%	30/120 Winter				105.336
1.013	S323	120 Winter	30	+0%	30/60 Winter				105.334
1.014	S324	120 Winter	30	+0%	30/15 Summer				105.334

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
5.001	S321	0.008	0.000	0.01			10.9	SURCHARGED	
1.012	S322	0.058	0.000	0.03			96.8	SURCHARGED	
1.013	S323	0.212	0.000	0.03			49.4	SURCHARGED	
1.014	S324	1.531	0.000	1.03			35.6	SURCHARGED	

STORM SEWER DESIGN

Rainfall Simulation

1:30 year event with Surcharged Outfall

Surcharged Outfall Details for Surface Network 3

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.014	S325	103.900	103.500	103.500	0	0

Datum (m) 103.400 Offset (mins) 0

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
1	1.000	42	1.000	83	1.000	124	1.000	165	1.000	206	1.000
2	1.000	43	1.000	84	1.000	125	1.000	166	1.000	207	1.000
3	1.000	44	1.000	85	1.000	126	1.000	167	1.000	208	1.000
4	1.000	45	1.000	86	1.000	127	1.000	168	1.000	209	1.000
5	1.000	46	1.000	87	1.000	128	1.000	169	1.000	210	1.000
6	1.000	47	1.000	88	1.000	129	1.000	170	1.000	211	1.000
7	1.000	48	1.000	89	1.000	130	1.000	171	1.000	212	1.000
8	1.000	49	1.000	90	1.000	131	1.000	172	1.000	213	1.000
9	1.000	50	1.000	91	1.000	132	1.000	173	1.000	214	1.000
10	1.000	51	1.000	92	1.000	133	1.000	174	1.000	215	1.000
11	1.000	52	1.000	93	1.000	134	1.000	175	1.000	216	1.000
12	1.000	53	1.000	94	1.000	135	1.000	176	1.000	217	1.000
13	1.000	54	1.000	95	1.000	136	1.000	177	1.000	218	1.000
14	1.000	55	1.000	96	1.000	137	1.000	178	1.000	219	1.000
15	1.000	56	1.000	97	1.000	138	1.000	179	1.000	220	1.000
16	1.000	57	1.000	98	1.000	139	1.000	180	1.000	221	1.000
17	1.000	58	1.000	99	1.000	140	1.000	181	1.000	222	1.000
18	1.000	59	1.000	100	1.000	141	1.000	182	1.000	223	1.000
19	1.000	60	1.000	101	1.000	142	1.000	183	1.000	224	1.000
20	1.000	61	1.000	102	1.000	143	1.000	184	1.000	225	1.000
21	1.000	62	1.000	103	1.000	144	1.000	185	1.000	226	1.000
22	1.000	63	1.000	104	1.000	145	1.000	186	1.000	227	1.000
23	1.000	64	1.000	105	1.000	146	1.000	187	1.000	228	1.000
24	1.000	65	1.000	106	1.000	147	1.000	188	1.000	229	1.000
25	1.000	66	1.000	107	1.000	148	1.000	189	1.000	230	1.000
26	1.000	67	1.000	108	1.000	149	1.000	190	1.000	231	1.000
27	1.000	68	1.000	109	1.000	150	1.000	191	1.000	232	1.000
28	1.000	69	1.000	110	1.000	151	1.000	192	1.000	233	1.000
29	1.000	70	1.000	111	1.000	152	1.000	193	1.000	234	1.000
30	1.000	71	1.000	112	1.000	153	1.000	194	1.000	235	1.000
31	1.000	72	1.000	113	1.000	154	1.000	195	1.000	236	1.000
32	1.000	73	1.000	114	1.000	155	1.000	196	1.000	237	1.000
33	1.000	74	1.000	115	1.000	156	1.000	197	1.000	238	1.000
34	1.000	75	1.000	116	1.000	157	1.000	198	1.000	239	1.000
35	1.000	76	1.000	117	1.000	158	1.000	199	1.000	240	1.000
36	1.000	77	1.000	118	1.000	159	1.000	200	1.000	241	1.000
37	1.000	78	1.000	119	1.000	160	1.000	201	1.000	242	1.000
38	1.000	79	1.000	120	1.000	161	1.000	202	1.000	243	1.000
39	1.000	80	1.000	121	1.000	162	1.000	203	1.000	244	1.000
40	1.000	81	1.000	122	1.000	163	1.000	204	1.000	245	1.000
41	1.000	82	1.000	123	1.000	164	1.000	205	1.000	246	1.000

Surcharged Outfall Details for Surface Network 3

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
247	1.000	266	1.000	285	1.000	304	1.000	323	1.000	342	1.000
248	1.000	267	1.000	286	1.000	305	1.000	324	1.000	343	1.000
249	1.000	268	1.000	287	1.000	306	1.000	325	1.000	344	1.000
250	1.000	269	1.000	288	1.000	307	1.000	326	1.000	345	1.000
251	1.000	270	1.000	289	1.000	308	1.000	327	1.000	346	1.000
252	1.000	271	1.000	290	1.000	309	1.000	328	1.000	347	1.000
253	1.000	272	1.000	291	1.000	310	1.000	329	1.000	348	1.000
254	1.000	273	1.000	292	1.000	311	1.000	330	1.000	349	1.000
255	1.000	274	1.000	293	1.000	312	1.000	331	1.000	350	1.000
256	1.000	275	1.000	294	1.000	313	1.000	332	1.000	351	1.000
257	1.000	276	1.000	295	1.000	314	1.000	333	1.000	352	1.000
258	1.000	277	1.000	296	1.000	315	1.000	334	1.000	353	1.000
259	1.000	278	1.000	297	1.000	316	1.000	335	1.000	354	1.000
260	1.000	279	1.000	298	1.000	317	1.000	336	1.000	355	1.000
261	1.000	280	1.000	299	1.000	318	1.000	337	1.000	356	1.000
262	1.000	281	1.000	300	1.000	319	1.000	338	1.000	357	1.000
263	1.000	282	1.000	301	1.000	320	1.000	339	1.000	358	1.000
264	1.000	283	1.000	302	1.000	321	1.000	340	1.000	359	1.000
265	1.000	284	1.000	303	1.000	322	1.000	341	1.000	360	1.000

Simulation Criteria for Surface Network 3

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.800	Storm Duration (mins)	30
Ratio R	0.281		

STORM SEWER DESIGN

Rainfall Simulation

1:100 year event +30% Climate Change

Simulation Criteria for Surface Network 3

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.800	Storm Duration (mins)	30
Ratio R	0.281		

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 3

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 1
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.281
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 18.800 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep Fine Inertia Status ON
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 100
Climate Change (%) 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S301	15 Winter	100	+30%	100/15 Summer				114.517
1.001	S302	15 Winter	100	+30%	100/15 Summer				114.306
1.002	S303	15 Winter	100	+30%	100/15 Summer				114.023
2.000	S304	15 Winter	100	+30%					115.706
2.001	S305	15 Winter	100	+30%					115.109
2.002	S306	15 Winter	100	+30%					114.497
1.003	S307	15 Winter	100	+30%	100/15 Summer				113.773
1.004	S308	15 Winter	100	+30%	100/15 Summer				112.918
1.005	S309	15 Winter	100	+30%	100/15 Summer				112.322
1.006	S310	15 Winter	100	+30%	100/15 Summer				111.506
1.007	S311	15 Winter	100	+30%					110.242
3.000	S312	15 Winter	100	+30%					112.553
1.008	S313	15 Winter	100	+30%					109.870
1.009	S314	15 Winter	100	+30%					109.461
1.010	S315	180 Winter	100	+30%	100/30 Summer				106.936
4.000	S316	15 Winter	100	+30%	100/15 Summer				110.526
4.001	S317	15 Winter	100	+30%	100/15 Summer				109.687
4.002	S318	15 Winter	100	+30%	100/15 Summer				108.016
1.011	S319	180 Winter	100	+30%	100/15 Winter				106.741
5.000	S320	180 Winter	100	+30%	100/15 Winter				106.740

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 3

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S301	0.542	0.000	1.40			51.0	SURCHARGED	
1.001	S302	0.444	0.000	1.60			58.7	SURCHARGED	
1.002	S303	0.288	0.000	1.06			85.1	SURCHARGED	
2.000	S304	-0.141	0.000	0.30			24.7	OK	
2.001	S305	-0.101	0.000	0.58			48.4	OK	
2.002	S306	-0.083	0.000	0.71			62.4	OK	
1.003	S307	0.272	0.000	0.96			164.9	SURCHARGED	
1.004	S308	0.322	0.000	1.05			174.0	SURCHARGED	
1.005	S309	0.266	0.000	1.13			191.5	SURCHARGED	
1.006	S310	0.083	0.000	1.05			201.7	SURCHARGED	
1.007	S311	-0.209	0.000	0.56			213.3	OK	
3.000	S312	-0.109	0.000	0.52			38.3	OK	
1.008	S313	-0.118	0.000	0.88			291.4	OK	
1.009	S314	-0.183	0.000	0.65			341.8	OK	
1.010	S315	1.048	0.000	0.33			140.5	SURCHARGED	
4.000	S316	0.699	0.000	1.47			37.3	SURCHARGED	
4.001	S317	1.809	0.000	1.62			41.9	SURCHARGED	
4.002	S318	2.365	0.000	2.77			68.8	SURCHARGED	
1.011	S319	1.439	0.000	0.12			160.1	SURCHARGED	
5.000	S320	1.328	0.000	0.01			14.2	SURCHARGED	

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 3

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
5.001	S321	180 Winter	100	+30%	100/15 Winter				106.740
1.012	S322	180 Winter	100	+30%	100/15 Winter				106.740
1.013	S323	180 Winter	100	+30%	100/15 Summer				106.739
1.014	S324	180 Winter	100	+30%	100/15 Summer				106.738

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
5.001	S321	1.413	0.000	0.01			23.0	SURCHARGED	
1.012	S322	1.462	0.000	0.07			187.8	SURCHARGED	
1.013	S323	1.617	0.000	0.10			193.2	SURCHARGED	
1.014	S324	2.935	0.000	1.20			41.8	FLOOD RISK	

Storm Water Network 4

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Surface Network 4

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	18.800	Add Flow / Climate Change (%)	0
Ratio R	0.281	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Surface Network 4

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	44.626	0.915	48.8	0.052	5.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	62.713	1.492	42.0	0.081	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	55.083	0.334	164.9	0.152	5.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	78.483	2.116	37.1	0.102	0.00	0.0	0.600	o	375	Pipe/Conduit	
3.000	21.967	0.295	74.5	0.015	5.00	0.0	0.600	o	225	Pipe/Conduit	
3.001	23.540	0.316	74.5	0.164	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	46.945	2.235	21.0	0.110	0.00	0.0	0.600	o	375	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.40	116.777	0.052	0.0	0.0	0.0	1.88	74.7	7.0
1.001	50.00	5.91	115.862	0.133	0.0	0.0	0.0	2.02	80.5	18.0
2.000	50.00	5.90	114.704	0.152	0.0	0.0	0.0	1.02	40.4	20.6
1.002	50.00	6.35	114.220	0.387	0.0	0.0	0.0	2.98	329.5	52.4
3.000	50.00	5.24	112.865	0.015	0.0	0.0	0.0	1.52	60.3	2.0
3.001	50.00	5.50	112.570	0.179	0.0	0.0	0.0	1.52	60.3	24.2
1.003	49.52	6.55	112.104	0.676	0.0	0.0	0.0	3.97	438.3	90.7

Network Design Table for Surface Network 4

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.004	20.767	0.052	399.4	0.046	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.005	31.022	0.078	397.7	0.054	0.00	0.0	0.600	o	1500	Pipe/Conduit	
1.006	25.220	0.063	400.3	0.054	0.00	0.0	0.600	o	1500	Pipe/Conduit	
1.007	14.107	0.035	403.1	0.077	0.00	0.0	0.600	o	1500	Pipe/Conduit	
1.008	6.573	0.047	139.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.004	48.47	6.89	109.794	0.722	0.0	0.0	0.0	1.01	160.8	94.8
1.005	47.77	7.13	108.692	0.776	0.0	0.0	0.0	2.14	3790.0	100.4
1.006	47.22	7.33	108.614	0.830	0.0	0.0	0.0	2.14	3777.6	106.1
1.007	46.91	7.44	108.551	0.907	0.0	0.0	0.0	2.13	3764.7	115.2
1.008	46.64	7.54	108.516	0.907	0.0	0.0	0.0	1.10	43.9«	115.2

Online Controls for Surface Network 4

Depth/Flow Relationship Manhole: S414, DS/PN: 1.008, Volume (m³): 38.0

Invert Level (m) 108.516

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.3600	0.800	20.7500	2.000	23.3300	3.200	29.5100
0.200	13.6600	1.000	19.4100	2.200	24.4700	3.400	30.4200
0.300	18.9100	1.200	18.8000	2.400	25.5600	3.600	31.3000
0.400	21.8000	1.400	19.5200	2.600	26.6000	3.800	32.1600
0.500	22.7900	1.600	20.8700	2.800	27.6000		
0.600	22.5500	1.800	22.1300	3.000	28.5700		

Storage Structures for Surface Network 4

Tank or Pond Manhole: S414, DS/PN: 1.008

Invert Level (m) 110.850

Depth (m)	**Area (m²)**	**Depth (m)**	**Area (m²)**
0.000	586.3	0.500	777.8

Manhole Schedules for Surface Network 4

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN (Pipe Out)	Pipe Out Invert Level (m)	Diameter (mm)	PN (Pipes In)	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
S401	118.355	1.578	Open Manhole	1350	1.000	116.777	225				
S402	118.935	3.073	Open Manhole	1500	1.001	115.862	225	1.000	115.862	225	
S404	116.328	1.624	Open Manhole	1350	2.000	114.704	225				
S405	116.856	2.636	Open Manhole	1800	1.002	114.220	375	1.001	114.370	225	
								2.000	114.370	225	
S407	114.456	1.591	Open Manhole	1350	3.000	112.865	225				
S408	114.523	1.953	Open Manhole	1350	3.001	112.570	225	3.000	112.570	225	
S409	114.256	2.152	Open Manhole	1800	1.003	112.104	375	1.002	112.104	375	
								3.001	112.254	225	
S410	112.505	2.711	Open Manhole	1500	1.004	109.794	450	1.003	109.869	375	
S411	111.719	3.027	Open Manhole	3000	1.005	108.692	1500	1.004	109.742	450	
S412	111.859	3.245	Open Manhole	3000	1.006	108.614	1500	1.005	108.614	1500	
S413	111.580	3.029	Open Manhole	3000	1.007	108.551	1500	1.006	108.551	1500	
S414	111.120	2.604	Open Manhole	3000	1.008	108.516	225	1.007	108.516	1500	
S415	108.700	0.231	Open Manhole	0		OUTFALL		1.008	108.469	225	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S401	360582.948	437865.029	360582.948	437865.029	Required	
S402	360618.846	437891.540	360618.846	437891.540	Required	
S404	360537.418	437909.396	360537.418	437909.396	Required	
S405	360581.742	437942.099	360581.742	437942.099	Required	
S407	360497.984	437978.850	360497.984	437978.850	Required	
S408	360516.085	437991.296	360516.085	437991.296	Required	
S409	360535.078	438005.203	360535.078	438005.203	Required	

Manhole Schedules for Surface Network 4

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S410	360507.343	438043.080	360507.343	438043.080	Required	
S411	360495.124	438059.871	360495.124	438059.871	Required	
S412	360468.964	438043.196	360468.964	438043.196	Required	
S413	360447.697	438029.641	360447.697	438029.641	Required	
S414	360435.030	438035.851	360435.030	438035.851	Required	
S415	360428.660	438037.473			No Entry	

STORM SEWER DESIGN

Rainfall Simulation

1:30 year event

Simulation Criteria for Surface Network 4

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.800	Storm Duration (mins)	30
Ratio R	0.281		

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 4

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 1
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.281
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 18.800 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep Fine Inertia Status ON
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 30
Climate Change (%) 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S401	15 Winter	30	+0%					116.847
1.001	S402	15 Winter	30	+0%					115.975
2.000	S404	15 Winter	30	+0%	30/15 Summer				114.967
1.002	S405	15 Winter	30	+0%					114.372
3.000	S407	15 Winter	30	+0%					112.907
3.001	S408	15 Winter	30	+0%					112.747
1.003	S409	15 Winter	30	+0%					112.288
1.004	S410	15 Winter	30	+0%	30/15 Summer				110.305
1.005	S411	120 Winter	30	+0%	30/120 Winter				110.252
1.006	S412	120 Winter	30	+0%	30/60 Winter				110.252
1.007	S413	120 Winter	30	+0%	30/60 Winter				110.252
1.008	S414	120 Winter	30	+0%	30/15 Summer				110.252

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S401	-0.155	0.000	0.20			14.5	OK	
1.001	S402	-0.112	0.000	0.49			38.3	OK	

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 4

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
2.000	S404	0.038	0.000	1.07			41.5	SURCHARGED	
1.002	S405	-0.223	0.000	0.34			106.2	OK	
3.000	S407	-0.183	0.000	0.08			4.2	OK	
3.001	S408	-0.048	0.000	0.97			53.9	OK	
1.003	S409	-0.191	0.000	0.47			188.0	OK	
1.004	S410	0.061	0.000	1.56			204.4	SURCHARGED	
1.005	S411	0.060	0.000	0.03			78.3	SURCHARGED	
1.006	S412	0.138	0.000	0.02			52.2	SURCHARGED	
1.007	S413	0.201	0.000	0.02			34.9	SURCHARGED	
1.008	S414	1.511	0.000	0.74			22.7	SURCHARGED	

STORM SEWER DESIGN

Rainfall Simulation

1:30 year event with Surcharged Outfall

Surcharged Outfall Details for Surface Network 4

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.008	S415	108.700	108.469	0.000	0	0

Datum (m) 108.370 Offset (mins) 0

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
1	1.000	42	1.000	83	1.000	124	1.000	165	1.000	206	1.000
2	1.000	43	1.000	84	1.000	125	1.000	166	1.000	207	1.000
3	1.000	44	1.000	85	1.000	126	1.000	167	1.000	208	1.000
4	1.000	45	1.000	86	1.000	127	1.000	168	1.000	209	1.000
5	1.000	46	1.000	87	1.000	128	1.000	169	1.000	210	1.000
6	1.000	47	1.000	88	1.000	129	1.000	170	1.000	211	1.000
7	1.000	48	1.000	89	1.000	130	1.000	171	1.000	212	1.000
8	1.000	49	1.000	90	1.000	131	1.000	172	1.000	213	1.000
9	1.000	50	1.000	91	1.000	132	1.000	173	1.000	214	1.000
10	1.000	51	1.000	92	1.000	133	1.000	174	1.000	215	1.000
11	1.000	52	1.000	93	1.000	134	1.000	175	1.000	216	1.000
12	1.000	53	1.000	94	1.000	135	1.000	176	1.000	217	1.000
13	1.000	54	1.000	95	1.000	136	1.000	177	1.000	218	1.000
14	1.000	55	1.000	96	1.000	137	1.000	178	1.000	219	1.000
15	1.000	56	1.000	97	1.000	138	1.000	179	1.000	220	1.000
16	1.000	57	1.000	98	1.000	139	1.000	180	1.000	221	1.000
17	1.000	58	1.000	99	1.000	140	1.000	181	1.000	222	1.000
18	1.000	59	1.000	100	1.000	141	1.000	182	1.000	223	1.000
19	1.000	60	1.000	101	1.000	142	1.000	183	1.000	224	1.000
20	1.000	61	1.000	102	1.000	143	1.000	184	1.000	225	1.000
21	1.000	62	1.000	103	1.000	144	1.000	185	1.000	226	1.000
22	1.000	63	1.000	104	1.000	145	1.000	186	1.000	227	1.000
23	1.000	64	1.000	105	1.000	146	1.000	187	1.000	228	1.000
24	1.000	65	1.000	106	1.000	147	1.000	188	1.000	229	1.000
25	1.000	66	1.000	107	1.000	148	1.000	189	1.000	230	1.000
26	1.000	67	1.000	108	1.000	149	1.000	190	1.000	231	1.000
27	1.000	68	1.000	109	1.000	150	1.000	191	1.000	232	1.000
28	1.000	69	1.000	110	1.000	151	1.000	192	1.000	233	1.000
29	1.000	70	1.000	111	1.000	152	1.000	193	1.000	234	1.000
30	1.000	71	1.000	112	1.000	153	1.000	194	1.000	235	1.000
31	1.000	72	1.000	113	1.000	154	1.000	195	1.000	236	1.000
32	1.000	73	1.000	114	1.000	155	1.000	196	1.000	237	1.000
33	1.000	74	1.000	115	1.000	156	1.000	197	1.000	238	1.000
34	1.000	75	1.000	116	1.000	157	1.000	198	1.000	239	1.000
35	1.000	76	1.000	117	1.000	158	1.000	199	1.000	240	1.000
36	1.000	77	1.000	118	1.000	159	1.000	200	1.000	241	1.000
37	1.000	78	1.000	119	1.000	160	1.000	201	1.000	242	1.000
38	1.000	79	1.000	120	1.000	161	1.000	202	1.000	243	1.000
39	1.000	80	1.000	121	1.000	162	1.000	203	1.000	244	1.000
40	1.000	81	1.000	122	1.000	163	1.000	204	1.000	245	1.000
41	1.000	82	1.000	123	1.000	164	1.000	205	1.000	246	1.000

Surcharged Outfall Details for Surface Network 4

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
247	1.000	266	1.000	285	1.000	304	1.000	323	1.000	342	1.000
248	1.000	267	1.000	286	1.000	305	1.000	324	1.000	343	1.000
249	1.000	268	1.000	287	1.000	306	1.000	325	1.000	344	1.000
250	1.000	269	1.000	288	1.000	307	1.000	326	1.000	345	1.000
251	1.000	270	1.000	289	1.000	308	1.000	327	1.000	346	1.000
252	1.000	271	1.000	290	1.000	309	1.000	328	1.000	347	1.000
253	1.000	272	1.000	291	1.000	310	1.000	329	1.000	348	1.000
254	1.000	273	1.000	292	1.000	311	1.000	330	1.000	349	1.000
255	1.000	274	1.000	293	1.000	312	1.000	331	1.000	350	1.000
256	1.000	275	1.000	294	1.000	313	1.000	332	1.000	351	1.000
257	1.000	276	1.000	295	1.000	314	1.000	333	1.000	352	1.000
258	1.000	277	1.000	296	1.000	315	1.000	334	1.000	353	1.000
259	1.000	278	1.000	297	1.000	316	1.000	335	1.000	354	1.000
260	1.000	279	1.000	298	1.000	317	1.000	336	1.000	355	1.000
261	1.000	280	1.000	299	1.000	318	1.000	337	1.000	356	1.000
262	1.000	281	1.000	300	1.000	319	1.000	338	1.000	357	1.000
263	1.000	282	1.000	301	1.000	320	1.000	339	1.000	358	1.000
264	1.000	283	1.000	302	1.000	321	1.000	340	1.000	359	1.000
265	1.000	284	1.000	303	1.000	322	1.000	341	1.000	360	1.000

Simulation Criteria for Surface Network 4

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.800	Storm Duration (mins)	30
Ratio R	0.281		

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 4

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 1
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.281
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 18.800 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep Fine Inertia Status ON
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 30
Climate Change (%) 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S401	15 Winter	30	+0%					116.847
1.001	S402	15 Winter	30	+0%					115.975
2.000	S404	15 Winter	30	+0%	30/15 Summer				114.967
1.002	S405	15 Winter	30	+0%					114.372
3.000	S407	15 Winter	30	+0%					112.907
3.001	S408	15 Winter	30	+0%					112.747
1.003	S409	15 Winter	30	+0%					112.288
1.004	S410	180 Winter	30	+0%	30/15 Summer				110.902
1.005	S411	180 Winter	30	+0%	30/60 Winter				110.895
1.006	S412	180 Winter	30	+0%	30/60 Summer				110.895
1.007	S413	180 Winter	30	+0%	30/60 Summer				110.895
1.008	S414	180 Winter	30	+0%	30/15 Summer				110.894

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S401	-0.155	0.000	0.20			14.5	OK	
1.001	S402	-0.112	0.000	0.49			38.3	OK	

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 4

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
2.000	S404	0.038	0.000	1.07			41.5	SURCHARGED	
1.002	S405	-0.223	0.000	0.34			106.2	OK	
3.000	S407	-0.183	0.000	0.08			4.2	OK	
3.001	S408	-0.048	0.000	0.97			53.9	OK	
1.003	S409	-0.191	0.000	0.47			188.0	OK	
1.004	S410	0.658	0.000	0.45			58.6	SURCHARGED	
1.005	S411	0.703	0.000	0.03			60.6	SURCHARGED	
1.006	S412	0.781	0.000	0.02			48.7	SURCHARGED	
1.007	S413	0.844	0.000	0.03			50.8	SURCHARGED	
1.008	S414	2.153	0.000	0.74			22.7	FLOOD RISK	

STORM SEWER DESIGN

Rainfall Simulation

1:100 year event +30% Climate Change

Simulation Criteria for Surface Network 4

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.800	Storm Duration (mins)	30
Ratio R	0.281		

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 4

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 1
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.281
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 18.800 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep Fine Inertia Status ON
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 100
Climate Change (%) 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S401	15 Winter	100	+30%					116.869
1.001	S402	15 Winter	100	+30%					116.022
2.000	S404	15 Winter	100	+30%	100/15 Summer				115.571
1.002	S405	15 Winter	100	+30%					114.421
3.000	S407	15 Winter	100	+30%	100/15 Summer				113.211
3.001	S408	15 Winter	100	+30%	100/15 Summer				113.199
1.003	S409	15 Winter	100	+30%					112.351
1.004	S410	120 Winter	100	+30%	100/15 Summer				111.082
1.005	S411	120 Winter	100	+30%	100/15 Summer				111.073
1.006	S412	120 Winter	100	+30%	100/15 Summer				111.072
1.007	S413	120 Winter	100	+30%	100/15 Summer				111.071
1.008	S414	120 Winter	100	+30%	100/15 Summer				111.071

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S401	-0.133	0.000	0.34			24.3	OK	
1.001	S402	-0.065	0.000	0.82			63.6	OK	

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 4

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
2.000	S404	0.642	0.000	1.66			64.5	SURCHARGED	
1.002	S405	-0.174	0.000	0.54			170.2	OK	
3.000	S407	0.121	0.000	0.19			10.5	SURCHARGED	
3.001	S408	0.404	0.000	1.49			82.7	SURCHARGED	
1.003	S409	-0.128	0.000	0.75			302.6	OK	
1.004	S410	0.838	0.000	0.96			125.3	SURCHARGED	
1.005	S411	0.881	0.000	0.06			134.1	SURCHARGED	
1.006	S412	0.958	0.000	0.06			142.5	SURCHARGED	
1.007	S413	1.020	0.000	0.10			154.1	SURCHARGED	
1.008	S414	2.330	0.000	0.86			26.4	FLOOD RISK	

Phase 1 - Foul Water Network 1

FOUL SEWERAGE DESIGN

Network Design Table for FW1 - PDS Export.FWS

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.000	21.577	0.755	28.6	0.000	6	0.0	1.500	o	150	🔒
1.001	10.136	0.507	20.0	0.000	0	0.0	1.500	o	150	🔓
1.002	9.531	0.071	135.0	0.000	6	0.0	1.500	o	150	🔓
1.003	36.247	0.324	111.9	0.000	0	0.0	1.500	o	150	🔓
1.004	36.094	0.690	52.3	0.000	0	0.0	1.500	o	150	🔓
1.005	9.292	0.069	135.0	0.000	3	0.0	1.500	o	150	🔓
1.006	7.293	0.054	135.0	0.000	0	0.0	1.500	o	150	🔓
1.007	29.244	0.491	59.6	0.000	0	0.0	1.500	o	150	🔓
1.008	9.888	0.482	20.5	0.000	8	0.0	1.500	o	150	🔓
2.000	46.275	1.361	34.0	0.000	200	0.0	1.500	o	150	🔒
2.001	35.226	1.761	20.0	0.000	5	0.0	1.500	o	150	🔓
2.002	10.901	0.081	134.6	0.000	5	0.0	1.500	o	150	🔓
2.003	23.107	0.098	235.8	0.000	195	0.0	1.500	o	225	🔓
2.004	25.222	1.264	20.0	0.000	0	0.0	1.500	o	225	🔓
1.009	27.745	0.118	235.1	0.000	0	0.0	1.500	o	225	🔓

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	107.117	0.000	0.0	6	0.0	11	0.50	1.64	29.0	0.3
1.001	106.362	0.000	0.0	6	0.0	10	0.57	1.97	34.7	0.3
1.002	105.855	0.000	0.0	12	0.0	21	0.37	0.75	13.3	0.6
1.003	105.784	0.000	0.0	12	0.0	20	0.39	0.83	14.6	0.6
1.004	105.460	0.000	0.0	12	0.0	17	0.51	1.21	21.4	0.6
1.005	104.770	0.000	0.0	15	0.0	24	0.39	0.75	13.3	0.7
1.006	104.702	0.000	0.0	15	0.0	24	0.39	0.75	13.3	0.7
1.007	104.648	0.000	0.0	15	0.0	19	0.52	1.14	20.1	0.7
1.008	104.157	0.000	0.0	23	0.0	18	0.86	1.94	34.3	1.1
2.000	108.240	0.000	0.0	200	0.0	62	1.37	1.51	26.6	9.4
2.001	106.879	0.000	0.0	205	0.0	54	1.68	1.96	34.7	9.6
2.002	105.118	0.000	0.0	210	0.0	96	0.83	0.75	13.3	9.8
2.003	104.962	0.000	0.0	405	0.0	131	0.79	0.75	29.7	19.0
2.004	104.864	0.000	0.0	405	0.0	66	1.97	2.58	102.4	19.0
1.009	103.600	0.000	0.0	428	0.0	136	0.80	0.75	29.7	20.1

FOUL SEWERAGE DESIGN

Network Design Table for FW1 - PDS Export.FWS

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.010	21.277	0.091	235.0	0.000	3	0.0	1.500	o	225	
1.011	9.211	0.039	235.0	0.000	7	0.0	1.500	o	225	
1.012	16.634	0.071	235.0	0.000	0	0.0	1.500	o	225	
1.013	34.291	1.593	21.5	0.000	2	0.0	1.500	o	225	
3.000	28.025	0.208	135.0	0.000	2	0.0	1.500	o	150	
3.001	23.238	0.332	70.0	0.000	0	0.0	1.500	o	150	
3.002	12.851	0.643	20.0	0.000	4	0.0	1.500	o	150	
3.003	28.939	1.453	19.9	0.000	7	0.0	1.500	o	150	
4.000	35.578	0.404	88.1	0.000	7	0.0	1.500	o	150	
4.001	13.249	0.103	128.9	0.000	4	0.0	1.500	o	150	
3.004	13.280	0.099	134.0	0.000	4	0.0	1.500	o	150	
5.000	32.509	1.086	29.9	0.000	4	0.0	1.500	o	150	
5.001	13.165	0.663	19.9	0.000	0	0.0	1.500	o	150	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.010	103.482	0.000	0.0	431	0.0	136	0.80	0.75	29.7	20.2
1.011	103.391	0.000	0.0	438	0.0	138	0.81	0.75	29.7	20.5
1.012	103.352	0.000	0.0	438	0.0	138	0.81	0.75	29.7	20.5
1.013	103.281	0.000	0.0	440	0.0	70	1.96	2.48	98.6	20.6
3.000	104.652	0.000	0.0	2	0.0	9	0.21	0.75	13.3	0.1
3.001	104.444	0.000	0.0	2	0.0	8	0.26	1.05	18.5	0.1
3.002	104.112	0.000	0.0	6	0.0	10	0.57	1.96	34.7	0.3
3.003	103.470	0.000	0.0	13	0.0	14	0.73	1.97	34.8	0.6
4.000	102.524	0.000	0.0	7	0.0	15	0.36	0.93	16.5	0.3
4.001	102.120	0.000	0.0	11	0.0	20	0.36	0.77	13.6	0.5
3.004	102.017	0.000	0.0	28	0.0	32	0.48	0.76	13.4	1.3
5.000	103.667	0.000	0.0	4	0.0	9	0.43	1.61	28.4	0.2
5.001	102.581	0.000	0.0	4	0.0	8	0.49	1.97	34.8	0.2

FOUL SEWERAGE DESIGN

Network Design Table for FW1 - PDS Export.FWS

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
3.005	20.894	0.155	134.8	0.000	0	0.0	1.500	o	150	
1.014	17.155	0.073	235.0	0.000	0	0.0	1.500	o	225	
1.015	13.743	0.058	235.0	0.000	2	0.0	1.500	o	225	
1.016	21.770	0.093	235.0	0.000	0	0.0	1.500	o	225	
1.017	11.274	0.162	69.6	0.000	8	0.0	1.500	o	225	
6.000	34.974	0.259	135.0	0.000	5	0.0	1.500	o	150	
7.000	13.792	0.521	26.5	0.000	8	0.0	1.500	o	150	
6.001	51.228	0.379	135.0	0.000	0	0.0	1.500	o	150	
6.002	27.732	0.590	47.0	0.000	13	0.0	1.500	o	150	
6.003	10.422	0.077	135.0	0.000	5	0.0	1.500	o	150	
6.004	56.806	0.421	135.0	0.000	0	0.0	1.500	o	750	
1.018	3.254	0.024	135.0	0.000	0	0.0	1.500	o	150	
1.019	185.986	-4.482	-41.5	0.000	0	0.0	1.500	o	300	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
3.005	101.918	0.000	0.0	32	0.0	34	0.50	0.75	13.3	1.5
1.014	101.688	0.000	0.0	472	0.0	145	0.82	0.75	29.7	22.1
1.015	101.615	0.000	0.0	474	0.0	145	0.82	0.75	29.7	22.2
1.016	101.557	0.000	0.0	474	0.0	145	0.82	0.75	29.7	22.2
1.017	101.464	0.000	0.0	482	0.0	101	1.31	1.38	54.8	22.6
6.000	103.029	0.000	0.0	5	0.0	14	0.28	0.75	13.3	0.2
7.000	103.291	0.000	0.0	8	0.0	12	0.56	1.71	30.2	0.4
6.001	102.770	0.000	0.0	13	0.0	22	0.38	0.75	13.3	0.6
6.002	102.390	0.000	0.0	26	0.0	24	0.67	1.28	22.6	1.2
6.003	101.800	0.000	0.0	31	0.0	34	0.49	0.75	13.3	1.5
6.004	101.723	0.000	0.0	31	0.0	22	0.39	2.15	950.7	1.5
1.018	101.302	0.000	0.0	513	0.0	150	0.75	0.75	13.3«	24.0
1.019	101.278	0.000	0.0	513	0.0	300	0.14	0.14	9.6«	24.0

FOUL SEWERAGE DESIGN

Network Design Table for FW1 - PDS Export.FWS

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.020	7.073	0.021	340.0	0.000	0	0.0	1.500	o	300	●

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.020	105.760	0.000	0.0	513	0.0	142	0.73	0.75	53.0	24.0

Manhole Schedules for FW1 - PDS Export.FWS

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
1	108.762	1.645	Open Manhole	1350	1.000	107.117	150				
2	108.164	1.802	Open Manhole	1200	1.001	106.362	150	1.000	106.362	150	
3	107.960	2.105	Open Manhole	1350	1.002	105.855	150	1.001	105.855	150	
4	107.858	2.074	Open Manhole	1200	1.003	105.784	150	1.002	105.784	150	
5	107.505	2.045	Open Manhole	1200	1.004	105.460	150	1.003	105.460	150	
6	107.578	2.808	Open Manhole	1200	1.005	104.770	150	1.004	104.770	150	
7	107.447	2.745	Open Manhole	1200	1.006	104.702	150	1.005	104.702	150	
8	107.337	2.689	Open Manhole	1200	1.007	104.648	150	1.006	104.648	150	
9	106.880	2.723	Open Manhole	1200	1.008	104.157	150	1.007	104.157	150	
20	109.898	1.658	Open Manhole	1200	2.000	108.240	150				
21	108.550	1.671	Open Manhole	1200	2.001	106.879	150	2.000	106.879	150	
22	107.328	2.210	Open Manhole	1350	2.002	105.118	150	2.001	105.118	150	
23	106.952	1.990	Open Manhole	1200	2.003	104.962	225	2.002	105.037	150	
24	106.615	1.751	Open Manhole	1200	2.004	104.864	225	2.003	104.864	225	
10	106.852	3.252	Open Manhole	1200	1.009	103.600	225	1.008	103.675	150	
								2.004	103.600	225	
11	106.898	3.416	Open Manhole	1200	1.010	103.482	225	1.009	103.482	225	
12	106.549	3.158	Open Manhole	1200	1.011	103.391	225	1.010	103.391	225	
13	106.397	3.045	Open Manhole	1200	1.012	103.352	225	1.011	103.352	225	
14	106.160	2.879	Open Manhole	1350	1.013	103.281	225	1.012	103.281	225	
25	106.302	1.650	Open Manhole	1200	3.000	104.652	150				
26	106.321	1.877	Open Manhole	1200	3.001	104.444	150	3.000	104.444	150	
27	105.875	1.763	Open Manhole	1200	3.002	104.112	150	3.001	104.112	150	
28	105.655	2.185	Open Manhole	1200	3.003	103.470	150	3.002	103.470	150	
31	105.283	2.759	Open Manhole	1200	4.000	102.524	150				
32	105.918	3.798	Open Manhole	1200	4.001	102.120	150	4.000	102.120	150	
29	105.942	3.925	Open Manhole	1200	3.004	102.017	150	3.003	102.017	150	
								4.001	102.017	150	
33	105.617	1.950	Open Manhole	1200	5.000	103.667	150				
34	105.795	3.214	Open Manhole	1200	5.001	102.581	150	5.000	102.581	150	
30	105.781	3.863	Open Manhole	1200	3.005	101.918	150	3.004	101.918	150	
								5.001	101.918	150	
15	105.682	3.994	Open Manhole	1350	1.014	101.688	225	1.013	101.688	225	
								3.005	101.763	150	

Manhole Schedules for FW1 - PDS Export.FWS

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
16	105.764	4.149	Open Manhole	1350	1.015	101.615	225	1.014	101.615	225	
17	105.885	4.328	Open Manhole	1200	1.016	101.557	225	1.015	101.557	225	
18	105.724	4.260	Open Manhole	1500	1.017	101.464	225	1.016	101.464	225	
36	105.595	2.566	Open Manhole	1200	6.000	103.029	150				
41	105.841	2.550	Open Manhole	1200	7.000	103.291	150				
37	106.021	3.251	Open Manhole	1200	6.001	102.770	150	6.000	102.770	150	
								7.000	102.770	150	
38	105.301	2.911	Open Manhole	1350	6.002	102.390	150	6.001	102.390	150	
39	104.996	3.196	Open Manhole	1200	6.003	101.800	150	6.002	101.800	150	
43	105.000	3.277	Open Manhole	2100	6.004	101.723	750	6.003	101.723	150	
19	105.800	4.498	Open Manhole	2400	1.018	101.302	150	1.017	101.302	225	
								6.004	101.302	750	
42	105.800	4.522	Open Manhole	1200	1.019	101.278	300	1.018	101.278	150	
44	108.350	2.590	Open Manhole	1200	1.020	105.760	300	1.019	105.760	300	
UU1802	108.570	2.831	Open Manhole	0		OUTFALL		1.020	105.739	300	

FOUL SEWERAGE DESIGN

Design Criteria for Foul Network 3

Pipe Sizes STANDARD Manhole Sizes STANDARD

Industrial Flow (l/s/ha)	0.00	Add Flow / Climate Change (%)	0
Industrial Peak Flow Factor	0.00	Minimum Backdrop Height (m)	0.200
Flow Per Person (l/per/day)	222.00	Maximum Backdrop Height (m)	1.500
Persons per House	3.00	Min Design Depth for Optimisation (m)	1.200
Domestic (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	1.00
Domestic Peak Flow Factor	6.00	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Foul Network 3

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	60.334	0.603	100.1	0.000	6	0.0	1.500	o	150	Pipe/Conduit	🔒
2.000	56.779	2.969	19.1	0.000	5	0.0	1.500	o	150	Pipe/Conduit	🔒
1.001	75.976	2.250	33.8	0.000	11	0.0	1.500	o	150	Pipe/Conduit	🔓
3.000	28.239	0.466	60.6	0.000	11	0.0	1.500	o	150	Pipe/Conduit	🔒
1.002	46.479	1.343	34.6	0.000	5	0.0	1.500	o	150	Pipe/Conduit	🔓
1.003	24.445	0.707	34.6	0.000	5	0.0	1.500	o	150	Pipe/Conduit	🔓
1.004	31.403	0.908	34.6	0.000	0	0.0	1.500	o	150	Pipe/Conduit	🔓
1.005	32.574	0.937	34.8	0.000	7	0.0	1.500	o	150	Pipe/Conduit	🔓
1.006	17.710	0.131	135.0	0.000	2	0.0	1.500	o	150	Pipe/Conduit	🔓
1.007	26.316	0.195	135.0	0.000	6	0.0	1.500	o	150	Pipe/Conduit	🔓

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	114.507	0.000	0.0	6	0.0	14	0.32	0.88	15.5	0.3
2.000	116.873	0.000	0.0	5	0.0	9	0.54	2.01	35.5	0.2
1.001	113.904	0.000	0.0	22	0.0	20	0.71	1.51	26.7	1.0
3.000	112.120	0.000	0.0	11	0.0	17	0.47	1.13	19.9	0.5
1.002	111.654	0.000	0.0	38	0.0	26	0.84	1.49	26.4	1.8
1.003	110.311	0.000	0.0	43	0.0	28	0.87	1.49	26.4	2.0
1.004	109.604	0.000	0.0	43	0.0	28	0.87	1.49	26.4	2.0
1.005	108.696	0.000	0.0	50	0.0	30	0.91	1.49	26.3	2.3
1.006	107.759	0.000	0.0	52	0.0	43	0.57	0.75	13.3	2.4
1.007	107.628	0.000	0.0	58	0.0	46	0.59	0.75	13.3	2.7

Network Design Table for Foul Network 3

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.008	28.432	0.211	135.0	0.000	0	0.0	1.500	o	150	Pipe/Conduit	🔓
1.009	14.716	0.154	95.7	0.000	8	0.0	1.500	o	150	Pipe/Conduit	🔓
4.000	22.656	2.248	10.1	0.000	11	0.0	1.500	o	150	Pipe/Conduit	🔒
1.010	9.126	0.091	100.3	0.000	0	0.0	1.500	o	150	Pipe/Conduit	🔓
5.000	29.446	0.260	113.3	0.000	8	0.0	1.500	o	150	Pipe/Conduit	🔒
5.001	23.998	0.212	113.2	0.000	8	0.0	1.500	o	150	Pipe/Conduit	🔓
1.011	57.766	1.457	39.6	0.000	0	0.0	1.500	o	150	Pipe/Conduit	🔓
1.012	25.668	0.190	135.0	0.000	0	0.0	1.500	o	150	Pipe/Conduit	🔓
1.013	25.667	0.145	177.0	0.000	3	0.0	1.500	o	225	Pipe/Conduit	🔓
1.014	26.249	0.141	186.2	0.000	3	0.0	1.500	o	225	Pipe/Conduit	🔓

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.008	107.433	0.000	0.0	58	0.0	46	0.59	0.75	13.3	2.7
1.009	107.223	0.000	0.0	66	0.0	45	0.69	0.90	15.8	3.1
4.000	109.317	0.000	0.0	11	0.0	11	0.87	2.77	49.0	0.5
1.010	107.069	0.000	0.0	77	0.0	49	0.71	0.87	15.5	3.6
5.000	107.450	0.000	0.0	8	0.0	17	0.34	0.82	14.5	0.4
5.001	107.190	0.000	0.0	16	0.0	23	0.42	0.82	14.5	0.7
1.011	106.978	0.000	0.0	93	0.0	42	1.04	1.39	24.6	4.3
1.012	105.521	0.000	0.0	93	0.0	59	0.67	0.75	13.3	4.3
1.013	105.256	0.000	0.0	96	0.0	55	0.59	0.86	34.3	4.4
1.014	105.111	0.000	0.0	99	0.0	56	0.59	0.84	33.4	4.6

Manhole Schedules for Foul Network 3

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
F301	116.135	1.628	Open Manhole	1350	1.000	114.507	150				
F302	118.523	1.650	Open Manhole	1200	2.000	116.873	150				
F303	116.560	2.656	Open Manhole	1800	1.001	113.904	150	1.000	113.904	150	
								2.000	113.904	150	
F305	114.158	2.038	Open Manhole	1200	3.000	112.120	150				
F306	113.928	2.274	Open Manhole	1350	1.002	111.654	150	1.001	111.654	150	
								3.000	111.654	150	
F307	112.317	2.006	Open Manhole	1200	1.003	110.311	150	1.002	110.311	150	
F308	111.461	1.857	Open Manhole	1350	1.004	109.604	150	1.003	109.604	150	
F309	111.705	3.009	Open Manhole	1200	1.005	108.696	150	1.004	108.696	150	
F310	111.341	3.582	Open Manhole	1200	1.006	107.759	150	1.005	107.759	150	
F311	111.072	3.444	Open Manhole	1350	1.007	107.628	150	1.006	107.628	150	
F312	110.592	3.159	Open Manhole	1200	1.008	107.433	150	1.007	107.433	150	
F313	110.160	2.937	Open Manhole	1200	1.009	107.223	150	1.008	107.223	150	
F314	110.967	1.650	Open Manhole	1200	4.000	109.317	150				
F315	109.998	2.929	Open Manhole	1200	1.010	107.069	150	1.009	107.069	150	
								4.000	107.069	150	
F316	109.019	1.569	Open Manhole	1350	5.000	107.450	150				
F317	109.714	2.524	Open Manhole	1350	5.001	107.190	150	5.000	107.190	150	
F318	109.577	2.599	Open Manhole	1350	1.011	106.978	150	1.010	106.978	150	
								5.001	106.978	150	
F319	107.205	1.684	Open Manhole	1200	1.012	105.521	150	1.011	105.521	150	
F320	107.189	1.933	Open Manhole	1350	1.013	105.256	225	1.012	105.331	150	
F321	106.834	1.723	Open Manhole	1200	1.014	105.111	225	1.013	105.111	225	
F23	106.952	1.982	Open Manhole	1200		OUTFALL		1.014	104.970	225	

Phase 2 - Foul Water Network 1

FOUL SEWERAGE DESIGN

Design Criteria for Foul Network 1

Pipe Sizes STANDARD Manhole Sizes STANDARD

Industrial Flow (l/s/ha)	0.00	Add Flow / Climate Change (%)	0
Industrial Peak Flow Factor	0.00	Minimum Backdrop Height (m)	0.200
Flow Per Person (l/per/day)	222.00	Maximum Backdrop Height (m)	1.500
Persons per House	3.00	Min Design Depth for Optimisation (m)	1.200
Domestic (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	1.00
Domestic Peak Flow Factor	6.00	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Foul Network 1

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	22.412	0.252	88.9	0.000	4	0.0	1.500	o	150	Pipe/Conduit	🔒
1.001	30.458	0.459	66.4	0.000	0	0.0	1.500	o	150	Pipe/Conduit	🔓
1.002	6.126	0.086	71.2	0.000	4	0.0	1.500	o	150	Pipe/Conduit	🔓
1.003	27.937	1.473	19.0	0.000	0	0.0	1.500	o	150	Pipe/Conduit	🔓
1.004	22.606	0.167	135.0	0.000	0	0.0	1.500	o	150	Pipe/Conduit	🔓
1.005	26.382	1.437	18.4	0.000	0	0.0	1.500	o	150	Pipe/Conduit	🔓
1.006	7.840	0.093	84.3	0.000	12	0.0	1.500	o	150	Pipe/Conduit	🔓

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	109.907	0.000	0.0	4	0.0	12	0.30	0.93	16.4	0.2
1.001	109.655	0.000	0.0	4	0.0	11	0.33	1.08	19.0	0.2
1.002	109.196	0.000	0.0	8	0.0	15	0.40	1.04	18.4	0.4
1.003	109.110	0.000	0.0	8	0.0	11	0.63	2.02	35.7	0.4
1.004	107.637	0.000	0.0	8	0.0	17	0.32	0.75	13.3	0.4
1.005	107.470	0.000	0.0	8	0.0	11	0.64	2.05	36.2	0.4
1.006	106.033	0.000	0.0	20	0.0	24	0.50	0.95	16.9	0.9

Phase 2 - Foul Water Network 2

FOUL SEWERAGE DESIGN

Design Criteria for Foul Network 2

Pipe Sizes STANDARD Manhole Sizes STANDARD

Industrial Flow (l/s/ha)	0.00	Add Flow / Climate Change (%)	0
Industrial Peak Flow Factor	0.00	Minimum Backdrop Height (m)	0.200
Flow Per Person (l/per/day)	222.00	Maximum Backdrop Height (m)	1.500
Persons per House	3.00	Min Design Depth for Optimisation (m)	1.200
Domestic (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	1.00
Domestic Peak Flow Factor	6.00	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Foul Network 2

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	19.011	0.190	100.1	0.000	8	0.0	1.500	o	150	Pipe/Conduit	🔒
1.001	17.079	0.127	134.5	0.000	0	0.0	1.500	o	150	Pipe/Conduit	🔓
1.002	41.497	0.384	108.1	0.000	5	0.0	1.500	o	150	Pipe/Conduit	🔓
2.000	23.674	0.696	34.0	0.000	3	0.0	1.500	o	150	Pipe/Conduit	🔒
2.001	30.655	1.482	20.7	0.000	0	0.0	1.500	o	150	Pipe/Conduit	🔓
1.003	33.461	0.903	37.1	0.000	5	0.0	1.500	o	150	Pipe/Conduit	🔓
1.004	18.393	0.136	135.2	0.000	4	0.0	1.500	o	150	Pipe/Conduit	🔓
1.005	19.269	0.143	134.7	0.000	3	0.0	1.500	o	150	Pipe/Conduit	🔓
1.006	25.847	0.897	28.8	0.000	0	0.0	1.500	o	150	Pipe/Conduit	🔓
3.000	19.008	0.190	100.0	0.000	15	0.0	1.500	o	150	Pipe/Conduit	🔒

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	113.450	0.000	0.0	8	0.0	16	0.36	0.88	15.5	0.4
1.001	113.260	0.000	0.0	8	0.0	17	0.32	0.75	13.3	0.4
1.002	113.133	0.000	0.0	13	0.0	21	0.40	0.84	14.9	0.6
2.000	114.927	0.000	0.0	3	0.0	8	0.37	1.51	26.6	0.1
2.001	114.231	0.000	0.0	3	0.0	7	0.44	1.93	34.1	0.1
1.003	112.749	0.000	0.0	21	0.0	20	0.68	1.44	25.5	1.0
1.004	111.846	0.000	0.0	25	0.0	30	0.46	0.75	13.3	1.2
1.005	111.710	0.000	0.0	28	0.0	32	0.47	0.75	13.3	1.3
1.006	111.567	0.000	0.0	28	0.0	22	0.81	1.64	28.9	1.3
3.000	110.860	0.000	0.0	15	0.0	22	0.43	0.88	15.5	0.7

Network Design Table for Foul Network 2

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.007	35.335	0.262	134.9	0.000	0	0.0	1.500	o	150	Pipe/Conduit	
1.008	21.005	1.541	13.6	0.000	6	0.0	1.500	o	150	Pipe/Conduit	
4.000	41.037	0.304	135.0	0.000	9	0.0	1.500	o	150	Pipe/Conduit	
1.009	47.405	0.627	75.6	0.000	12	0.0	1.500	o	150	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.007	110.670	0.000	0.0	43	0.0	39	0.54	0.75	13.3	2.0
1.008	110.408	0.000	0.0	49	0.0	24	1.25	2.38	42.1	2.3
4.000	109.171	0.000	0.0	9	0.0	18	0.33	0.75	13.3	0.4
1.009	108.867	0.000	0.0	70	0.0	43	0.76	1.01	17.8	3.2

Manhole Schedules for Foul Network 2

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
F201	116.004	2.554	Open Manhole	1200	1.000	113.450	150				
F202	115.678	2.418	Open Manhole	1200	1.001	113.260	150	1.000	113.260	150	
F203	115.449	2.316	Open Manhole	1200	1.002	113.133	150	1.001	113.133	150	
F204	116.727	1.800	Open Manhole	1200	2.000	114.927	150				
F205	116.037	1.806	Open Manhole	1200	2.001	114.231	150	2.000	114.231	150	
F206	115.110	2.361	Open Manhole	1350	1.003	112.749	150	1.002	112.749	150	
								2.001	112.749	150	
F207	114.027	2.181	Open Manhole	1200	1.004	111.846	150	1.003	111.846	150	
F208	113.592	1.882	Open Manhole	1350	1.005	111.710	150	1.004	111.710	150	
F209	113.271	1.704	Open Manhole	1200	1.006	111.567	150	1.005	111.567	150	
F210	113.209	2.349	Open Manhole	1200	3.000	110.860	150				
F211	112.960	2.290	Open Manhole	1350	1.007	110.670	150	1.006	110.670	150	
								3.000	110.670	150	
F212	112.258	1.850	Open Manhole	1200	1.008	110.408	150	1.007	110.408	150	
F213	110.962	1.791	Open Manhole	1200	4.000	109.171	150				
F214	111.576	2.709	Open Manhole	1350	1.009	108.867	150	1.008	108.867	150	
								4.000	108.867	150	
F20	109.898	1.658	Open Manhole	1200		OUTFALL		1.009	108.240	150	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
F201	360511.445	437892.161	360511.445	437892.161	Required	
F202	360496.874	437879.950	360496.874	437879.950	Required	
F203	360487.094	437865.949	360487.094	437865.949	Required	
F204	360525.779	437821.377	360525.779	437821.377	Required	
F205	360502.279	437818.513	360502.279	437818.513	Required	
F206	360472.818	437826.985	360472.818	437826.985	Required	

Manhole Schedules for Foul Network 2

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
F207	360440.629	437836.123	360440.629	437836.123	Required	
F208	360428.727	437850.145	360428.727	437850.145	Required	
F209	360424.604	437868.968	360424.604	437868.968	Required	
F210	360429.710	437904.575	360429.710	437904.575	Required	
F211	360414.742	437892.859	360414.742	437892.859	Required	
F212	360379.412	437893.476	360379.412	437893.476	Required	
F213	360339.489	437866.868	360339.489	437866.868	Required	
F214	360360.317	437902.228	360360.317	437902.228	Required	
F20	360321.419	437929.324			No Entry	

Phase 2 - Foul Water Network 3

FOUL SEWERAGE DESIGN

Design Criteria for Foul Network 3

Pipe Sizes STANDARD Manhole Sizes STANDARD

Industrial Flow (l/s/ha)	0.00	Add Flow / Climate Change (%)	0
Industrial Peak Flow Factor	0.00	Minimum Backdrop Height (m)	0.200
Flow Per Person (l/per/day)	222.00	Maximum Backdrop Height (m)	1.500
Persons per House	3.00	Min Design Depth for Optimisation (m)	1.200
Domestic (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	1.00
Domestic Peak Flow Factor	6.00	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Foul Network 3

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	60.334	0.603	100.1	0.000	7	0.0	1.500	o	150	Pipe/Conduit	
2.000	56.779	2.969	19.1	0.000	6	0.0	1.500	o	150	Pipe/Conduit	
1.001	75.976	2.250	33.8	0.000	12	0.0	1.500	o	150	Pipe/Conduit	
3.000	28.239	0.466	60.6	0.000	13	0.0	1.500	o	150	Pipe/Conduit	
1.002	46.479	1.343	34.6	0.000	5	0.0	1.500	o	150	Pipe/Conduit	
1.003	24.445	0.707	34.6	0.000	6	0.0	1.500	o	150	Pipe/Conduit	
1.004	31.403	0.908	34.6	0.000	0	0.0	1.500	o	150	Pipe/Conduit	
1.005	32.574	0.937	34.8	0.000	2	0.0	1.500	o	150	Pipe/Conduit	
1.006	17.710	0.131	135.2	0.000	7	0.0	1.500	o	150	Pipe/Conduit	
1.007	26.316	0.195	135.0	0.000	3	0.0	1.500	o	150	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	114.507	0.000	0.0	7	0.0	15	0.34	0.88	15.5	0.3
2.000	116.873	0.000	0.0	6	0.0	10	0.57	2.01	35.5	0.3
1.001	113.904	0.000	0.0	25	0.0	22	0.74	1.51	26.7	1.2
3.000	112.120	0.000	0.0	13	0.0	18	0.49	1.13	19.9	0.6
1.002	111.654	0.000	0.0	43	0.0	28	0.87	1.49	26.4	2.0
1.003	110.311	0.000	0.0	49	0.0	30	0.91	1.49	26.4	2.3
1.004	109.604	0.000	0.0	49	0.0	30	0.91	1.49	26.4	2.3
1.005	108.696	0.000	0.0	51	0.0	31	0.92	1.49	26.3	2.4
1.006	107.759	0.000	0.0	58	0.0	46	0.59	0.75	13.3	2.7
1.007	107.628	0.000	0.0	61	0.0	47	0.60	0.75	13.3	2.8

Network Design Table for Foul Network 3

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.008	28.432	0.211	134.7	0.000	0	0.0	1.500	o	150	Pipe/Conduit	🔓
1.009	14.716	0.154	95.6	0.000	9	0.0	1.500	o	150	Pipe/Conduit	🔓
4.000	22.656	2.248	10.1	0.000	15	0.0	1.500	o	150	Pipe/Conduit	🔒
1.010	9.126	0.091	100.3	0.000	0	0.0	1.500	o	150	Pipe/Conduit	🔓
5.000	29.446	0.260	113.3	0.000	8	0.0	1.500	o	150	Pipe/Conduit	🔒
5.001	23.998	0.213	112.7	0.000	8	0.0	1.500	o	150	Pipe/Conduit	🔓
1.011	57.766	1.457	39.6	0.000	0	0.0	1.500	o	150	Pipe/Conduit	🔓
1.012	25.668	0.190	135.1	0.000	0	0.0	1.500	o	150	Pipe/Conduit	🔓
1.013	25.667	0.145	177.0	0.000	3	0.0	1.500	o	225	Pipe/Conduit	🔓
1.014	26.249	0.141	186.2	0.000	4	0.0	1.500	o	225	Pipe/Conduit	🔓

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.008	107.433	0.000	0.0	61	0.0	47	0.60	0.75	13.3	2.8
1.009	107.222	0.000	0.0	70	0.0	46	0.70	0.90	15.8	3.2
4.000	109.317	0.000	0.0	15	0.0	13	0.96	2.77	49.0	0.7
1.010	107.068	0.000	0.0	85	0.0	52	0.73	0.87	15.5	3.9
5.000	107.450	0.000	0.0	8	0.0	17	0.34	0.82	14.5	0.4
5.001	107.190	0.000	0.0	16	0.0	23	0.42	0.82	14.6	0.7
1.011	106.977	0.000	0.0	101	0.0	44	1.07	1.39	24.6	4.7
1.012	105.520	0.000	0.0	101	0.0	61	0.69	0.75	13.3	4.7
1.013	105.255	0.000	0.0	104	0.0	57	0.61	0.86	34.3	4.8
1.014	105.110	0.000	0.0	108	0.0	59	0.60	0.84	33.4	5.0

Manhole Schedules for Foul Network 3

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
F301	116.381	1.874	Open Manhole	1350	1.000	114.507	150				
F302	118.700	1.827	Open Manhole	1200	2.000	116.873	150				
F303	116.825	2.921	Open Manhole	1800	1.001	113.904	150	1.000	113.904	150	
								2.000	113.904	150	
F305	114.524	2.404	Open Manhole	1200	3.000	112.120	150				
F306	114.309	2.655	Open Manhole	1350	1.002	111.654	150	1.001	111.654	150	
								3.000	111.654	150	
F307	112.576	2.265	Open Manhole	1200	1.003	110.311	150	1.002	110.311	150	
F308	111.640	2.036	Open Manhole	1350	1.004	109.604	150	1.003	109.604	150	
F309	111.857	3.161	Open Manhole	1200	1.005	108.696	150	1.004	108.696	150	
F310	111.492	3.733	Open Manhole	1200	1.006	107.759	150	1.005	107.759	150	
F311	111.216	3.588	Open Manhole	1350	1.007	107.628	150	1.006	107.628	150	
F312	110.710	3.277	Open Manhole	1200	1.008	107.433	150	1.007	107.433	150	
F313	110.267	3.045	Open Manhole	1200	1.009	107.222	150	1.008	107.222	150	
F314	111.086	1.769	Open Manhole	1200	4.000	109.317	150				
F315	110.112	3.044	Open Manhole	1200	1.010	107.068	150	1.009	107.068	150	
								4.000	107.069	150	1
F316	109.169	1.719	Open Manhole	1350	5.000	107.450	150				
F317	109.853	2.663	Open Manhole	1350	5.001	107.190	150	5.000	107.190	150	
F318	109.682	2.705	Open Manhole	1350	1.011	106.977	150	1.010	106.977	150	
								5.001	106.977	150	
F319	107.323	1.803	Open Manhole	1200	1.012	105.520	150	1.011	105.520	150	
F320	107.336	2.081	Open Manhole	1350	1.013	105.255	225	1.012	105.330	150	
F321	106.984	1.874	Open Manhole	1200	1.014	105.110	225	1.013	105.110	225	
F23	106.952	1.983	Open Manhole	1200		OUTFALL		1.014	104.969	225	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
F301	360534.166	437908.238	360534.166	437908.238	Required	
F302	360616.360	437898.323	360616.360	437898.323	Required	
F303	360582.715	437944.060	360582.715	437944.060	Required	

Manhole Schedules for Foul Network 3

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
F305	360514.794	437988.492	360514.794	437988.492	Required	
F306	360537.578	438005.175	360537.578	438005.175	Required	
F307	360510.027	438042.608	360510.027	438042.608	Required	
F308	360495.925	438062.576	360495.925	438062.576	Required	
F309	360469.391	438045.780	360469.391	438045.780	Required	
F310	360441.868	438028.358	360441.868	438028.358	Required	
F311	360424.802	438023.626	360424.802	438023.626	Required	
F312	360399.443	438016.594	360399.443	438016.594	Required	
F313	360374.699	438002.590	360374.699	438002.590	Required	
F314	360381.771	437977.818	360381.771	437977.818	Required	
F315	360364.270	437992.207	360364.270	437992.207	Required	
F316	360314.887	437966.073	360314.887	437966.073	Required	
F317	360339.658	437981.726	360339.658	437981.726	Required	
F318	360357.194	437997.970	360357.194	437997.970	Required	
F319	360319.984	438042.155	360319.984	438042.155	Required	

Manhole Schedules for Foul Network 3

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
F320	360299.350	438026.888	360299.350	438026.888	Required	
F321	360278.717	438011.621	360278.717	438011.621	Required	
F23	360259.016	437994.275			No Entry	